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THIS SOIL SURVEY CONTAINS INFORMATION THAT CAN BE APPLIED IN MANAGING FARMS, RANCHES AND WOODLANDS; IN SELECTING SITES FOR ROADS, PONDS, BUILDINGS AND OTHER STRUCTURES; AND IN JUDGING THE SUITABILITY OF TRACTS OF LANDS FOR FARMING, INDUSTRY AND RECREATION. ALL THE SOILS OF ADAMS COUNTY ARE SHOWN ON A DETAILED MAP AT THE BACK OF THIS PUBLICATION. THIS MAP CONSISTS OF MANY SHEETS MADE FROM AERIAL PHOTOGRAPHS. ON EACH SHEET OF THE DETAILED MAP, SOIL AREAS ARE OUTLINED AND IDENTIFIED BY SYMBOLS. THE "GUIDE TO MAPPING UNITS" LIST ALL THE SOILS OF THE COUNTY, BY MAP SYMBOL AND GIVES THE CAPABILITY CLASSIFICATION OF EACH. IT ALSO SHOWS THE PAGE WHERE EACH SOIL IS DESCRIBED IN THE TEXT.

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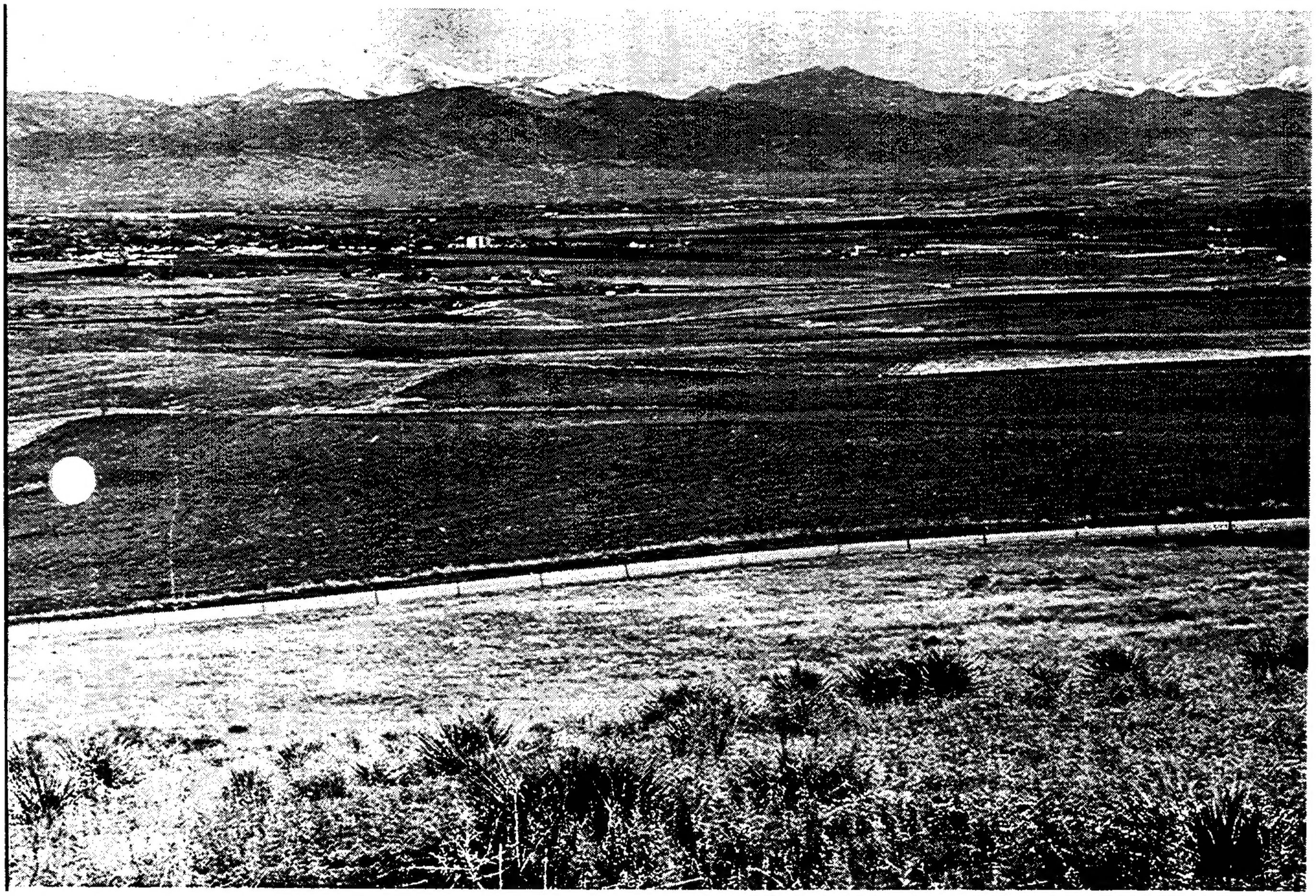
SOIL SURVEY OF

Adams County, Colorado



United States Department of Agriculture
Soil Conservation Service
In cooperation with
Colorado Agricultural Experiment Station

Issued October 1974

Major fieldwork for the soil survey was done in the period 1963–66. Soil names and descriptions were approved in 1967. Unless otherwise indicated, statements in the publication refer to conditions in the county in 1966. This survey was made cooperatively by the Soil Conservation Service and the Colorado Agricultural Experiment Station. It is part of the technical assistance furnished to the West Adams, East Adams, Deertrail, Boulder Valley, and Southeast Weld Soil Conservation Districts.

Either enlarged or reduced copies of the soil map in this publication can be made by commercial photographers, or they can be purchased on individual order from the Cartographic Division, Soil Conservation Service, United States Department of Agriculture, Washington, D.C. 20250.

HOW TO USE THIS SOIL SURVEY

THIS SOIL SURVEY contains information that can be applied in managing farms, ranches, and woodlands; in selecting sites for roads, ponds, buildings, and other structures; and in judging the suitability of tracts of land for farming, industry, and recreation.

Locating Soils

All the soils of Adams County are shown on the detailed map at the back of this publication. This map consists of many sheets made from aerial photographs. Each sheet is numbered to correspond with a number on the Index to Map Sheets.

On each sheet of the detailed map, soil areas are outlined and are identified by symbols. All areas marked with the same symbol are the same kind of soil. The soil symbol is inside the area if there is enough room; otherwise, it is outside and a pointer shows where the symbol belongs.

Finding and Using Information

The "Guide to Mapping Units" can be used to find information. This guide lists all the soils of the county in alphabetic order by map symbol and gives the capability classification of each. It also shows the page where each soil is described and the page for the capability unit, range site, and tree planting suitability group in which the soil has been placed.

Individual colored maps showing the relative suitability or degree of limitation of soils for many specific purposes can be developed by using the soil map and the information in the text. Translucent material can be used as an overlay over the soil map and colored to show soils that have the same limitation or suitability. For example, soils that have a slight limitation for a given use can be colored green, those with a moderate limitation can be colored yellow, and those with a severe limitation can be colored red.

Farmers and those who work with farmers can learn about use and management of the soils from the soil descriptions and from the discussions of the interpretative groupings.

Foresters and others can refer to the section "Use and Management of the Soils for Trees and Shrubs," where the soils of the county are grouped according to their suitability for trees and shrubs.

Game managers, sportsmen, and others can find information about soils and wildlife in the section "Use of the Soils for Wildlife."

Ranchers and others can find, under "Use and Management of the Soils for Range," groupings of the soils according to their suitability for range and also the names of many of the plants that grow on each range site.

Community planners and others can read about soil properties that affect the choice of sites for nonindustrial buildings and for recreation areas in the section "Community Development."

Engineers and builders can find, under "Engineering Uses of the Soils," tables that contain information about soil features that affect engineering practices.

Scientists and others can read about how the soils formed and how they are classified in the section "Formation and Classification of the Soils."

Newcomers in Adams County may be especially interested in the section "General Soil Map," where broad patterns of soils are described. They may also be interested in the information about the county given in the section "General Nature of the County."

Cover: Typical landscape in the western part of Adams County. The smooth grassland soils in the foreground and the adjacent nonirrigated areas are Renohill and Ulm soils. The more nearly level irrigated soils near the trees and buildings are Nunn soils. Snow-capped Rocky Mountains are in the background.

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Contents

Issued October 1974

SOIL SURVEY OF ADAMS COUNTY, COLORADO

BY JOHN J. SAMPSON AND THOMAS G. BABER, SOIL CONSERVATION SERVICE

FIELDWORK BY THOMAS G. BABER, JOHN J. SAMPSON, AND CHARLES P. PRENTISS, SOIL CONSERVATION SERVICE

UNITED STATES DEPARTMENT OF AGRICULTURE, SOIL CONSERVATION SERVICE, IN COOPERATION WITH THE COLORADO AGRICULTURAL EXPERIMENT STATION

ADAMS COUNTY covers an area of about 1,250 square miles, or 800,500 acres, in north-central Colorado (fig. 1). It forms a rectangle 72 miles long and 18 miles wide over most of its length, except in the vicinity of Denver County. It is at an elevation of 4,500 to 5,570 feet and consists of a nearly treeless plain over most of its area. Brighton is the county seat. The population is declining slowly in the farming areas and is increasing and expanding rapidly in urban areas in the western fourth of the county.

The economy in most of the county is based on farming and some ranching. About 70 square miles in the southwestern part of the county has been taken over by industrial and community development and is in a continual and rapid rate of expansion. This area was formerly used for irrigated crops and truck farming. The present irrigated acreage in the county is about 155,000 acres. Sugar beets, corn, alfalfa, small grains, and vegetables are important crops. Winter wheat and barley are grown on approximately 360,000 acres of nonirrigated soils, and the remaining 240,000 acres are unsuitable for cultivation or are in native grasses used for grazing.

Water for irrigation is supplied from wells or is diverted from the South Platte River, Clear Creek, and various sources in the mountains to the west and stored in reservoirs.

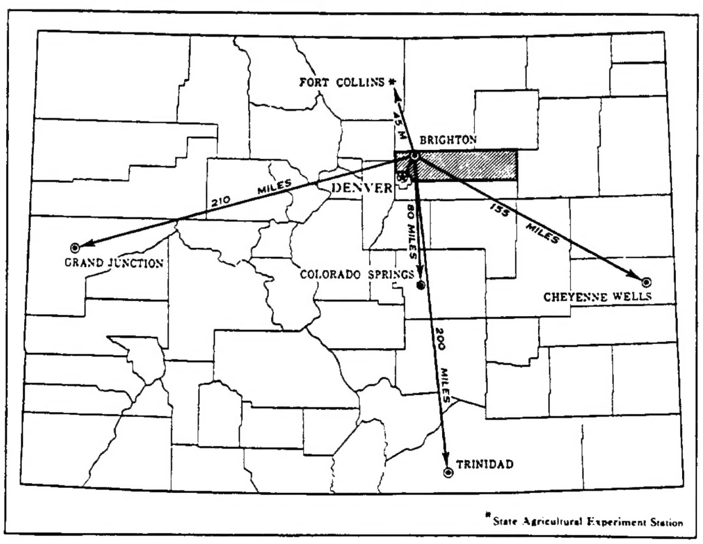

Figure 1.—**Location of Adams County in Colorado.**

The nonirrigated area is semiarid, and periods of drought 1 to 2 years in length are fairly common.

How This Survey Was Made

Soil scientists made this survey to learn what kinds of soil are in Adams County, where they are located, and how they can be used. The soil scientists went into the county knowing they likely would find many soils they had already seen and perhaps some they had not. They observed the steepness, length, and shape of slopes; the size and speed of streams; the kinds of native plants or crops; the kinds of rock; and many facts about the soils. They dug many holes to expose soil profiles. A profile is the sequence of natural layers, or horizons, in a soil; it extends from the surface down into the parent material that has not been changed much by leaching or by the action of plant roots.

The soil scientists made comparisons among the profiles they studied, and they compared these profiles with those in counties nearby and in places more distant. They classified and named the soils according to nationwide, uniform procedures. The *soil series* and the *soil phase* are the categories of soil classification most used in a local survey.

Soils that have profiles almost alike make up a soil series. Except for different texture in the surface layer, all the soils of one series have major horizons that are similar in thickness, arrangement, and other important characteristics. Each soil series is named for a town or other geographic feature near the place where a soil of that series was first observed and mapped. Ascalon and Nunn series, for example, are the names of two soil series. All the soils in the United States having the same series name are essentially alike in those characteristics that affect their behavior in the undisturbed landscape.

Soils of one series can differ in texture of the surface layer and in slope, stoniness, or some other characteristic that affects use of the soils by man. On the basis of such difference, a soil series is divided into phases. The name of a soil phase indicates a feature that affects management. For example, Ascalon loamy sand, 0 to 3 percent slopes, is one of several phases within the Ascalon series.

After a guide for classifying and naming the soils had been worked out, the soil scientists drew the boundaries of the individual soils on aerial photographs. The photographs show woodlands, buildings, field borders, trees, and other details that help in drawing boundaries accurately. The soil map at the back of this publication was prepared from the aerial photographs.

The areas shown on a soil map are called mapping units. On most maps detailed enough to be useful in planning the management of farms and fields, a mapping unit is nearly equivalent to a soil phase. It is not exactly equivalent, because it is not practical to show on such a map all the small, scattered bits of soil of some other kind that have been seen within an area that is dominantly of a recognized soil phase.

Some mapping units are made up of soils of different series, or of different phases within one series. Two such kinds of mapping units are shown on the soil map of Adams County: the soil complex and the soil association.

A soil complex consists of areas of two or more soils, so intermingled or so small in size that they cannot be shown separately on the soil map. Each area of a complex contains some of each of the two or more dominant soils, and the patterns and relative proportions are about the same in all areas. The name of a soil complex consists of the names of the dominant soils, joined by a hyphen. Shingle-Renohill loams, 5 to 25 percent slopes, is an example.

A soil association is made up of adjacent soils that occur as areas large enough to be shown individually on the soil map but are shown as one unit because the time and effort of delineating them separately cannot be justified. There is a considerable degree of uniformity in pattern and relative extent of the dominant soils, but the soils may differ greatly one from another. The name of an association consists of the names of the dominant soils, joined by a hyphen. Blakeland-Truckton association is an example.

In most areas surveyed there are places where the soil material is so rocky, so shallow, so severely eroded, or so variable in texture that it cannot be classified by soil series. These places are shown on the soil map and are described in the survey, but they are called land types and are given descriptive names. Gullied land is a land type in Adams County.

While a soil survey is in progress, samples of soils are taken, as needed, for laboratory measurements and for engineering tests. Laboratory data from the same kinds of soil in other places are assembled. Data on yields of crops under defined practices are assembled from farm records and from field or plot experiments on the same kinds of soil. Yields under defined management are estimated for all the soils.

But only part of a soil survey is done when the soils have been named, described, and delineated on the map, and the laboratory data and yield data have been assembled. The mass of detailed information then needs to be organized in such a way as to be readily useful to different groups of users, among them farmers, managers of woodland and rangeland, and engineers.

On the basis of yield and practice tables and other data, the soil scientists set up trial groups. They test these groups by further study and by consultation with farmers, agronomists, engineers, and others, then adjust the groups according to the results of their studies and consultation. Thus, the groups that are finally evolved reflect up-to-date knowledge of the soils and their behavior under present methods of use and management.

General Soil Map

The general soil map at the back of this survey shows, in color, the soil associations in Adams County. A soil association is a landscape that has a distinctive proportional pattern of soils. It normally consists of one or more major soils and at least one minor soil, and it is named for the major soils. The soils in one association may occur in another, but in a different pattern.

A map showing soil associations is useful to people who want a general idea of the soils in a county, who want to compare different parts of a county, or who want to know the location of large tracts that are suitable for a certain kind of use. Such a map is a useful general guide in managing a watershed, a wooded tract, or a wildlife area, or in planning engineering works, recreational facilities, and community developments. It is not a suitable map for planning the management of a farm or field, or for selecting the exact location of a road, building, or similar structure, because the soils in any one association ordinarily differ in slope, depth, stoniness, drainage, and other characteristics that affect management.

The soil associations in Adams County are discussed in the following pages.

1. Weld-Adena-Colby association

Nearly level to steep, well-drained, loamy soils formed in wind-laid deposits; on uplands

This association is in the higher lying areas of the county (fig. 2).

This association occupies about 40 percent of the county. About 30 percent is made up of Weld soils, 20 percent of Adena soils, 15 percent of Colby soils, and 35 percent of minor soils.

Weld soils have a brown loam surface layer and a brown clay subsoil. Lime has accumulated at a depth of 10 to 20 inches.

Adena soils generally are gently sloping. These soils are similar to Weld soils, but they have a thinner surface layer and subsoil and contain lime nearer to the surface. They have a grayish-brown loam surface layer and a dark-brown silty clay loam subsoil. Lime has accumulated at a depth of 6 to 10 inches.

Colby soils are on ridgetops and steep side slopes. They have a brown loam surface layer and a pale-brown loam and fine sandy loam underlying layer.

Also in this association are Deertrail soils, which make up about 10 percent of the association, and Wiley soils, which make up 10 percent. Wiley soils were not mapped individually in Adams County but are in small areas in association with other soils.

Deertrail soils are intermingled with Weld soils. They commonly occur as barren slick spots within areas of the Weld soils.

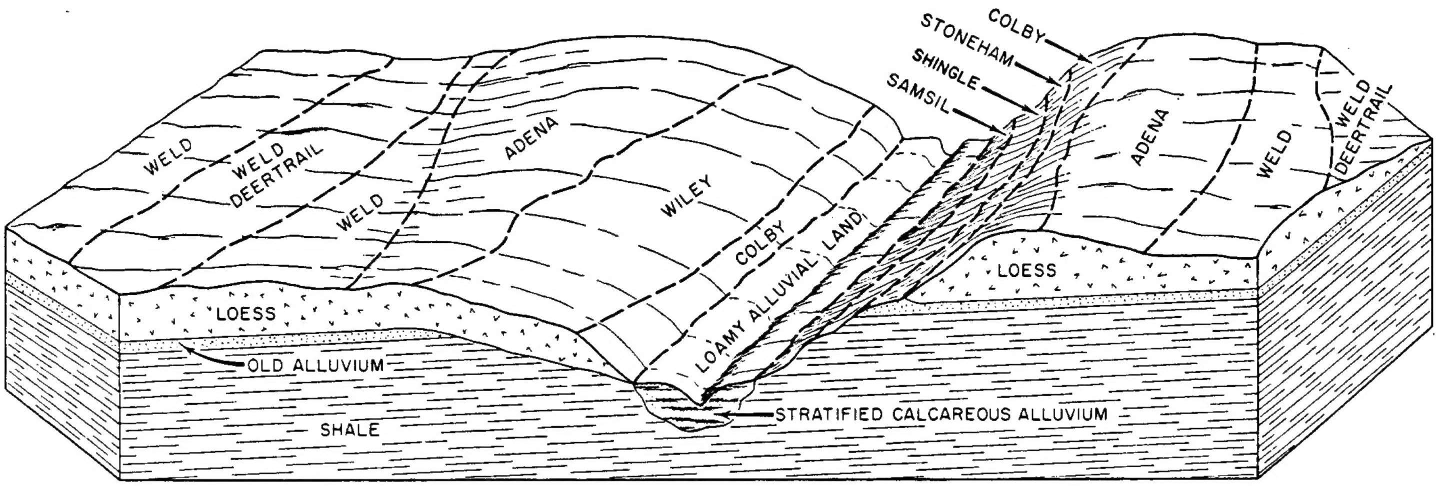

***Figure 2.*—Typical pattern of soils in the Weld-Adena-Colby association.**

Other minor soils in the association are the Shingle, Samsil, and Stoneham soils and Loamy alluvial land. The Samsil and Shingle soils have the steeper slopes where interbedded shale and sandstone are near the surface. Stoneham soils also generally have steeper slopes but are underlain by old alluvial sand and gravel. Loamy alluvial land is in the drainageways. Shingle soils make up about 3 percent of the association; Samsil soils, about 2 percent; Stoneham soils, about 5 percent; and Loamy alluvial land, about 5 percent.

Much of this association is cultivated, and crops of winter wheat, barley, and feed sorghums are good to very good in years that have average or above average rainfall. There are failures and near failures of crops in drier years. The farms in the association are mainly of the cash-grain type, but many farmers raise cattle. A large part of this association is in large ranch operations in the eastern third of the county. Soil blowing is active on all parts of the association that are not protected. Erosion is severe on steeper soils.

Roads are not always maintained in areas used for ranching, but the rest of the association is mostly accessible by maintained gravelled roads or good county roads. Gravel is scarce.

2. *Samsil-Shingle association*

Sloping to steep, excessively drained, clayey and loamy soils formed in materials from soft shale and sandstone; on uplands

This association is in small areas throughout most of the county, but the largest area is west of the South Platte River.

This association occupies about 3 percent of the county. About 35 percent is made up of Samsil soils, about 25 percent of Shingle soils and about 40 percent of minor soils.

Samsil soils have a pale-olive clay surface layer. The underlying layer is olive silty clay that contains visible salts, mostly gypsum, in the lower part. Interbedded shale and sandstone are at a depth of 6 to 20 inches.

Shingle soils are light brownish-gray and light yellowish-brown loam that is underlain by interbedded shale and sandstone at a depth of 10 to 20 inches.

Also in this association are Renohill and Ulm soils, which together make up about 5 percent of the association. They are in smooth areas. The remaining 35 percent of the association consists of steep Gravelly land that is closely intermingled with Shale outcrop; Terrace escarpments; Rough broken land; and Loamy alluvial land.

Most of this association has a cover of native grasses and is used as pasture for cattle and sheep. Parts of this association are within the areas near Denver that are being developed for industrial sites and homesites. The underlying shale and sandstone are generally fractured, and foundations can be damaged. Some of the shale in this association contains salts that can cause corrosion of metal and of water and drainage pipes if moisture is present. Care in preparation for foundation locations helps to prevent settling and fracturing of structures. The soils of this association are severely limited for use as leaching fields for septic tanks. The areas better suited to industrial and homesite development are at the edges of gravelly terraces or where gravel caps on the shale and sandstone are more than 6 feet thick.

Only a few roads are present, and gravel for roads is scarce except for the limited amounts in areas of Gravelly land and outcrops of shale.

3. *Ascalon-Vona-Truckton association*

Nearly level to strongly sloping, well-drained and somewhat excessively drained, loamy and sandy soils formed in wind-laid deposits; on uplands

This association is on uplands and is generally adjacent to large streams and creeks east of the South Platte River (fig. 3).

This association occupies about 22 percent of the county. About 30 percent is made up of Ascalon soils, about 20 percent of Vona soils, about 20 percent of Truckton soils, and the remaining 30 percent of minor soils.

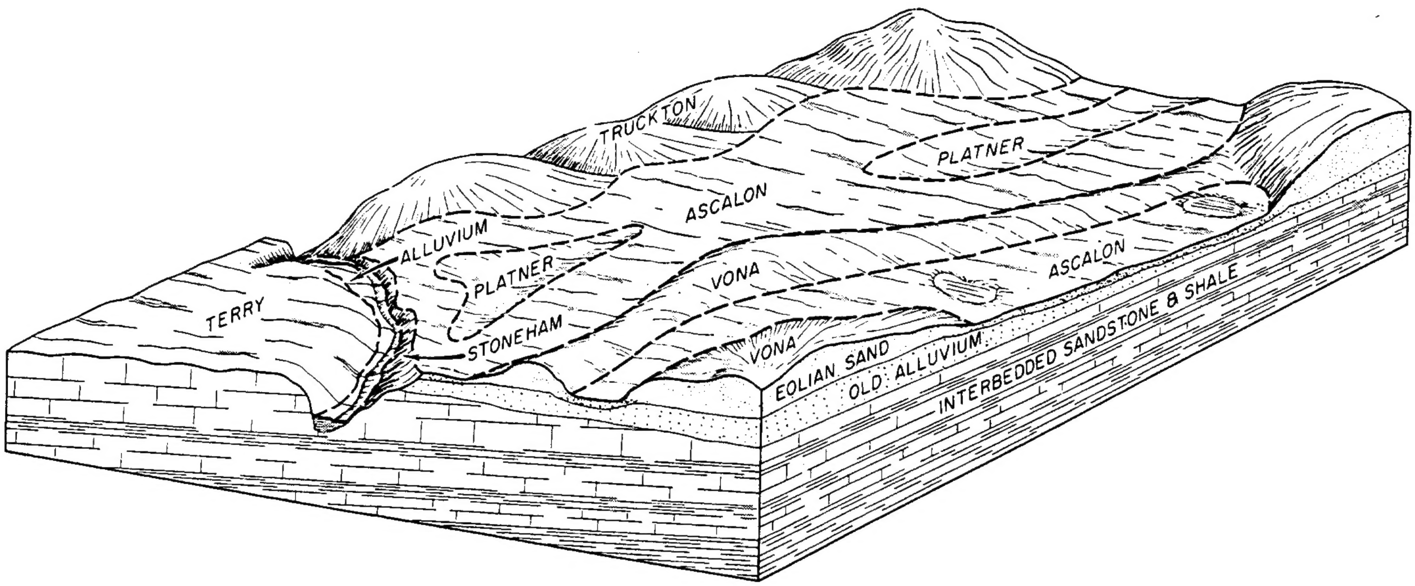

***Figure 3.*—Typical pattern of soils in the Ascalon-Vona-Truckton association.**

Ascalon soils have a brown sandy loam or loamy sand surface layer and a brown sandy clay loam subsoil. Lime has accumulated at a depth of 12 to 30 inches.

Vona soils have a light brownish-gray sandy loam or loamy sand surface layer and a pale-brown coarse sandy loam subsoil. Lime has accumulated at a depth of 11 to 30 inches.

Truckton soils have a dark grayish-brown sandy loam or loamy sand surface layer and a brown to dark-brown sandy loam subsoil.

Also in this association are soils of the Terry and Platner series. Terry soils make up about 15 percent of this association. They are generally in lower positions and are gently sloping. Platner soils make up about 10 percent of the association. They are in lower lying or more nearly level areas. The remaining 5 percent of the association is made up of wet-weather lakes, variable alluvium in the bottom of drainageways, and a few steep areas of steep Stoneham soils.

About 60 percent of the association is cultivated, and the remaining 40 percent is reseeded to adapted grasses or is in native grass. The soils are suitable for the production of deep-rooted mid and tall grasses, such as sand bluestem, sandreed, needle-and-thread, big bluestem, and little bluestem. Most of these soils have no major limitations for home construction and furnish good footing for foundations, are easily excavated, and present few, if any, drainage problems. Leaching wells and filter fields function satisfactorily in most soils in this association. This association is a fair to good source of sand but is a poor source of gravel.

4. Nunn-Satanta association

Nearly level, well-drained, loamy soils formed in alluvial materials that are underlain by gravel in some places; on terraces and fans

This association consists of nearly level, loamy soils that are mainly on terraces of the South Platte River and Clear, Box Elder, Kiowa, Comanche, and Antelope Creeks.

This association occupies about 3 percent of the county. About 40 percent is made up of Nunn soils, 30 percent of Satanta soils, and the remaining 30 percent of minor soils.

Nunn soils have a grayish-brown loam and clay loam surface layer and a dark grayish-brown clay subsoil. Lime has accumulated below a depth of 20 inches. Some areas have gravel and sand below a depth of 40 inches.

Satanta soils have a brown loam surface layer and a brown clay subsoil. Lime has accumulated at a depth of about 20 inches.

Also in this association are soils of the Vona and the Dacono series, each of which makes up about 10 percent of the association. Loamy alluvial land, Terrace escarpments, and gravel pits together make up 10 percent of the association.

This association is well suited to use for housing developments because most of the soils have few limitations for excavation, have moderate to low shrink-swell potential, and are easily drained. The sand and gravel substratum is excellent for establishing septic tanks, leaching fields, and leaching wells, and it gives good footing for structural foundations.

Most areas in this association are readily accessible by good roads. Many of the roads are paved, and most of the remaining roads have a gravel surface.

5. Alluvial land association

Nearly level, poorly drained to well-drained, loamy and sandy soils formed in stream and river deposits; on flood plains

This association is mainly in bottom lands along the South Platte River and Clear, Sand, Box Elder, Lost, Kiowa, Comanche, Bijou, Badger, and Coal Creeks (fig

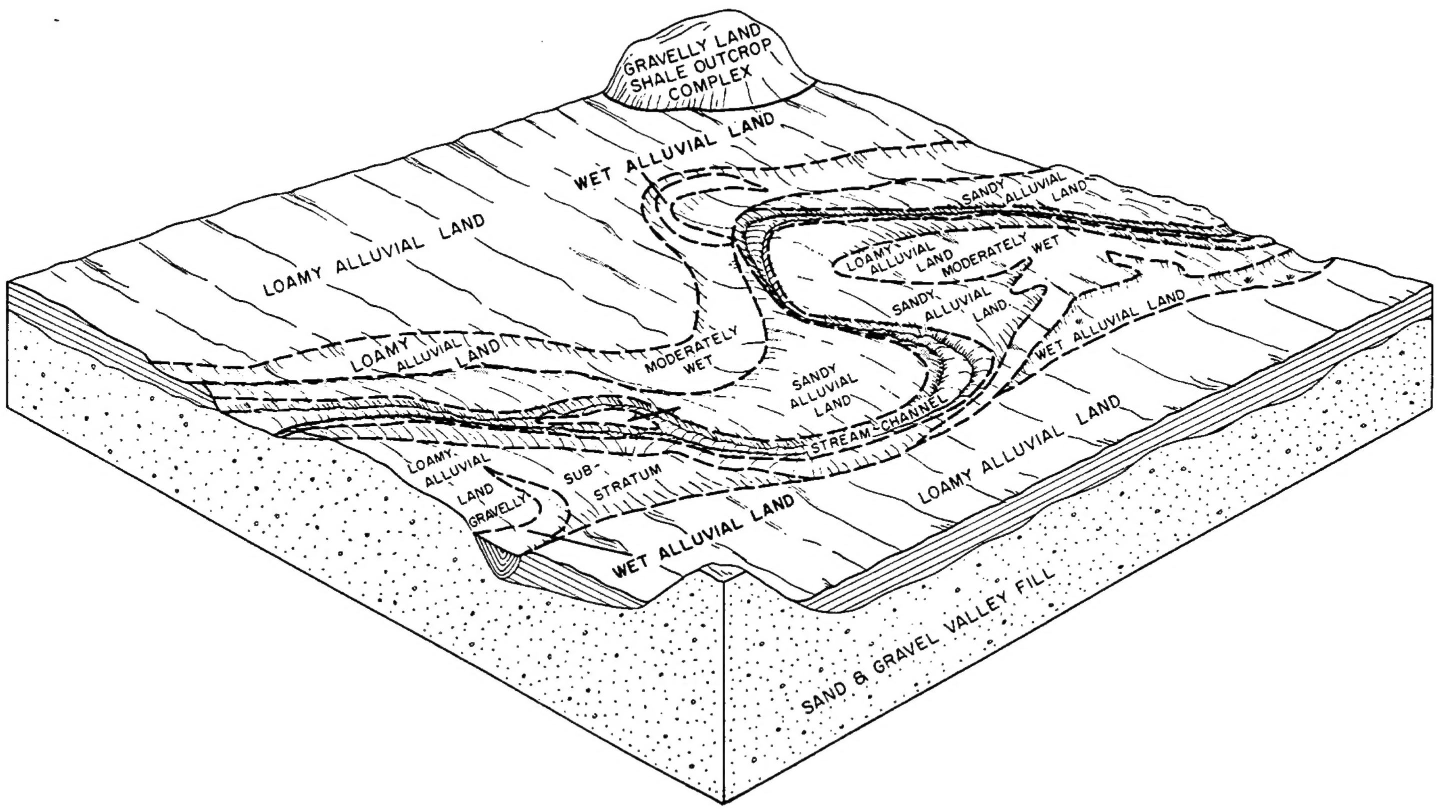

***Figure 4.*—Typical pattern of soils in the Alluvial land association.**

This association occupies 6 percent of the county. About 40 percent is made up of Loamy alluvial land, about 20 percent of Loamy alluvial land, moderately wet, about 20 percent of Sandy alluvial land, and the remaining 20 percent of minor soils.

Loamy alluvial land consists of dark-colored, loamy soils that contain layers of clay loam and sandy loam. It is on second bottoms of the South Platte River and creeks of the county and in drainageways on uplands. It is frequently flooded by water from higher lying soils and from stream overflow.

Loamy alluvial land, moderately wet, occupies the bottom of all the major drainageways throughout the county. It is similar to Loamy alluvial land, but it has a high water table and is commonly underlain by sand and gravel at depths of 20 to 36 inches.

Sandy alluvial land commonly is at the lowest elevations adjacent to creeks and other streams. These materials are stratified with sand and loamy sand and in many areas have a water table within a depth of 3 feet.

Also in this association are Wet alluvial land; Loamy alluvial land, gravelly substratum; stream channels; and gravel pits, which together make up 20 percent of the association.

Most crops suited to the county can be grown on the three kinds of Loamy alluvial lands if management is good. Sandy alluvial land and Wet alluvial land are unsuitable for cultivation, but they provide some grazing use for livestock. Soils of the association are of limited use as sites for buildings because flooding is frequent.

Roads provide access to this association throughout most of the county.

6. Terry-Renohill-Tassel association

Gently sloping to steep, well-drained and somewhat excessively drained, loamy soils formed in materials from soft sandstone and shale; on uplands

This association is in the steeper areas of the uplands in the eastern part of the county (fig. 5).

This association occupies about 8 percent of the county. About 40 percent is made up of Terry soils, about 25 percent of Renohill soils, about 20 percent of Tassel soils, and the remaining 15 percent of minor soils.

Terry soils have a brown fine sandy loam surface and a pale-brown fine sandy loam subsoil. Soft sandstone is between depths of 20 and 40 inches. Lime has generally accumulated at a depth of 20 inches or less.

Renohill soils have a grayish-brown loam surface layer and a light yellowish-brown to grayish-brown clay subsoil. Shale is between depths of 20 and 36 inches.

Tassel soils have a pale-brown fine sandy loam surface layer and very pale brown fine sandy loam to loamy fine sand underlying material. Interbedded soft sandstone and sandy shale are at a depth of 10 to 20 inches.

Some areas of Tassell and Terry soils contain rough sandstone outcrops.

Figure 5.—Typical area of the Terry-Renohill-Tassel association.

Also in this association are Colby, Shingle, and Ulm soils and Loamy alluvial land. Ulm soils and Loamy alluvial land are mainly in swales. Shingle soils are generally along edges of the steeper, narrow drainageways, and Colby soils are on high narrow ridges.

Most areas of this association have a cover of native grass and are used for grazing by cattle and sheep. Parts of large cattle ranches are in this association. Only a few small areas are cultivated, and these are parts of large dryfarming operations that are centered in adjacent soil associations where the soils are more suitable for cultivated crops. Many fields in this association have been abandoned or reseeded to grass.

About one graded road per township is in this association. A few privately maintained trail roads aid in reaching the more remote areas.

7. *Blakeland-Valent-Terry association*

Undulating to hilly, somewhat excessively drained, dominantly sandy soils: on uplands

This association is in hilly areas that are scattered throughout the county east of the South Platte River.

This association occupies about 4 percent of the county. About 40 percent is made up of Blakeland soils, about 25 percent of Valent soils, about 15 percent of Terry soils, and the remaining 20 percent of minor soils.

Blakeland soils have a grayish-brown loamy sand surface layer and brown and pale-brown loamy sand and sand underlying material.

Valent soils have a pale-brown loamy sand surface layer and light brownish-gray to pale-brown loamy sand to sand underlying material.

Blakeland and Valent soils occupy the rougher part of the association.

Terry soils have a brown fine sandy loam surface layer and a pale-brown fine sandy loam subsoil. They are underlain by fine-grained sandstone at a depth of 20 to 40 inches. Terry soils occupy the intermediate slopes in the association.

Also in this association are Tassel, Truckton, and Vona soils, wet-weather lakes, a few small sand dunes, and sandy alluvium on bottoms of drainageways. A few sandstone outcrops are present within areas of Tassel soils. Only a few wet-weather lakes are larger than 2 acres.

Most areas of this association have a grass cover of sand dropseed, needle-and-thread, three-awn, blue grama, and side-oats grama that is used for grazing by cattle and sheep. The grazing potential is very high in this association.

Only about 10 percent of this association is cultivated. This area is used primarily to raise feed sorghums. Some additional areas were cultivated at one time but have been reseeded to grass. Soil blowing is a hazard, and many of the knobs, ridges, and steep slopes were severely damaged by wind when they were cultivated. This association is a fair source of sand but is a poor source of gravel.

Graveled or graded roads are about 3 miles apart, and a few trail roads provide access to the more remote areas.

8. *Arvada-Heldt-Nunn association*

Nearly level, well-drained, loamy and clayey soils formed in alluvium; on terraces and fans

This association is in terrace positions in all but the eastern one-fourth of the county.

This association occupies about 4 percent of the county. About 40 percent is made up of Arvada soils, about 35 percent of Heldt soils, about 15 percent of Nunn soils, and the remaining 10 percent of minor soils.

Arvada soils have characteristic slickspots. They have a light brownish-gray loam surface layer and a grayish-brown clay subsoil. A water table is present in places. In many areas the soils are stratified.

Heldt soils are light brownish-gray clay to clay loam in their surface layer and subsoil. A water table is present in some places.

Nunn soils have a grayish-brown loam and clay loam surface layer and a dark grayish-brown clay loam subsoil. They are well drained. Lime has accumulated below a depth of 20 inches. Some areas have gravel and sand below a depth of 40 inches.

Also in this association are Truckton and Vona soils and Loamy alluvial land.

Arvada soils and Loamy alluvial land are generally unsuitable for cultivation and are used mostly for grazing by cattle. Fair to good grass production is possible under good management in some areas. Alkali sacaton, western wheatgrass, blue grama, and saltgrass are adapted native grasses. Heldt, Nunn, and Vona soils are more suitable for cultivation. Heldt soils are fair, and Nunn soils are fair to good for dryland farming in years when moisture is sufficient. Heldt, Nunn, and Vona soils are good for irrigated cropland. Alfalfa, sugar beets, corn, onions, and small grains are raised when irrigation water is available. Winter wheat, barley, and feed sorghums are the main dryfarmed crops.

Housing construction plans should include careful selection of sites in this association, as Arvada and Heldt soils both have high shrink-swell potential that could cause damage to foundations and breakage of water and drain pipes. Truckton and Vona soils furnish support for foundations.

Suitable locations for roads and highways are limited in this association, as most of it is subject to stream overflow almost every year.

9. *Platner-Ulm-Renohill association*

Nearly level to strongly sloping, well-drained, loamy soils formed in old alluvium on interbedded shale and sandstone; on uplands

This association is in higher upland areas in the western one-third of the county (fig. 6).

This association occupies about 10 percent of the county. About 40 percent is made up of Platner soils, about 30 percent of Ulm soils, about 20 percent of Renohill soils, and the remaining 10 percent of minor soils.

Platner soils have a grayish-brown loam surface layer and a brown clay subsoil. They are underlain by highly calcareous old alluvial wash materials and are in the nearly level high areas of the association.

Ulm soils have a light brownish-gray loam surface layer and a pale-brown silty clay and clay subsoil. They are calcareous below a depth of 20 inches. Interbedded shale is below a depth of 40 inches in many areas. Ulm soils are in the more sloping parts of the association.

Renohill soils are similar to Ulm soils, except that bedrock is between depths of 20 and 36 inches.

Also in this association are Samsil, Shingle, and Stoneham soils, Loamy alluvial land, and small areas of sandstone and gravel outcrops.

Much of the association is now cultivated, and a large percentage is irrigated. Platner, Stoneham, Ulm, and some Renohill soils are suitable for cultivation. Good dryland crops are raised most years. The crops respond well to irrigation. Developing homesites is difficult on Samsil, Shingle, Renohill, and Ulm soils, because these soils contain sandstone or shale, or both, at or above a depth of 4 feet. Protecting foundations is necessary. The deeper, more gently sloping soils are better for this use. Platner, Stoneham, and Ulm soils give poor support for foundations and for road construction. Limitations of

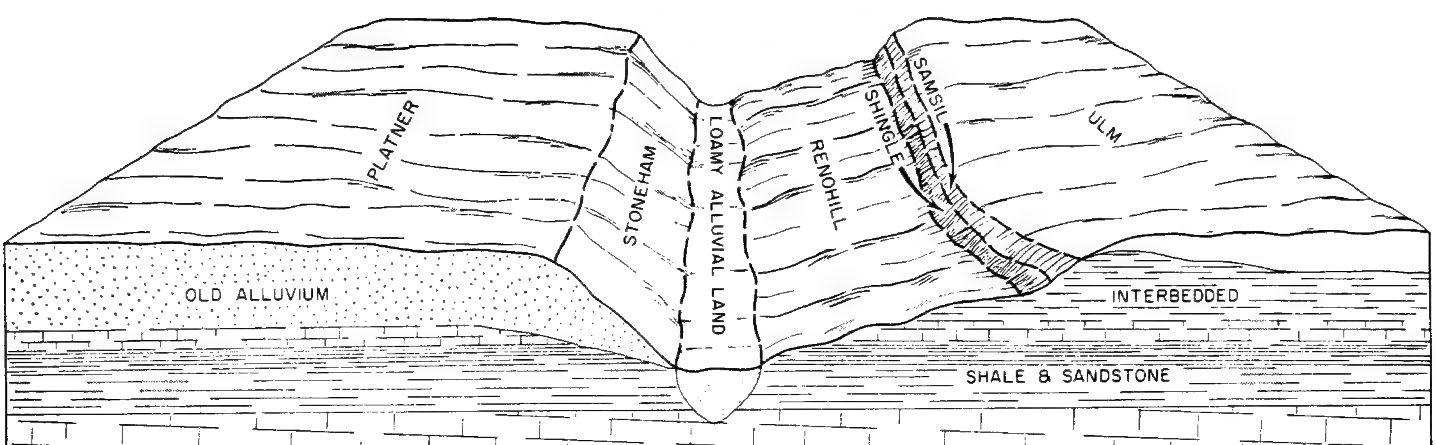

***Figure 6.*—Typical pattern of soils in the Platner-Ulm-Renohill association**

the soils for home sewerage systems with leaching fields and wells are severe. The supply of gravel is limited in the association.

Most areas of the association are accessible by section-line roads.

Descriptions of the Soils

In this section the soils of Adams County are described in detail. The procedure is to describe first the soil series and then the mapping units in that series. Thus, to get full information on any one mapping unit, it is necessary to read both the description of that unit and the description of the soil series to which the unit belongs.

Each soil series description contains a short narrative description of a profile considered representative of the series and a much more detailed description of the same profile that scientists, engineers, and others can use in making highly technical interpretations. The colors described are for dry soil, unless otherwise noted.

Some of the terms used in the soil descriptions and other sections are defined in the Glossary, in the "Soil Survey Manual," *(5)* [1] and some are defined in the section "How This Survey Was Made." The approximate acreage and proportionate extent of each soil mapp are shown in table 1. At the back of this soil survey .. the "Guide to Mapping Units," which lists the mapping units in the county and shows the capability unit (irrigated, nonirrigated, or both), range site, and tree planting group each mapping unit is in, and the page where each of these groups is described.

[1] Italic numbers in parentheses refer to Literature Cited, p. 70.

Adena Series

The Adena series is made up of well-drained, nearly level to gently sloping soils on uplands. These soils formed in wind-deposited loamy materials.

In a representative profile (fig. 7), the surface layer is grayish-brown loam about 4 inches thick. It is noncalcareous. The upper part of the subsoil is dark-brown heavy clay loam about 3 inches thick. It is noncalcareous. The lower part of the subsoil is very pale brown silty clay loam about 11 inches thick. It is highly calcareous and contains much visible lime. The underlying material is highly calcareous, very pale brown silty clay loam and light-gray silt loam that extends to a depth of 60 inches or more.

TABLE 1.—*Approximate acreage and proportionate extent of the soils*

Soil	Acres	Percent
Adena loam, 0 to 3 percent slopes	18, 600	2. 4
Adena loam, 3 to 5 percent slopes	2, 400	. 3
Adena-Colby association, gently sloping	67, 700	8. 1
Adena-Colby association, moderately sloping	35, 600	5. 1
Arvada loam, 0 to 3 percent slopes	18, 800	2. 3
Ascalon loamy sand, 0 to 3 percent slopes	700	. 1
Ascalon loamy sand, 3 to 5 percent slopes	1, 100	. 1
Ascalon sandy loam, 1 to 3 percent slopes	43, 000	5. 4
Ascalon sandy loam, 3 to 5 percent slopes	17, 300	2. 2
Ascalon sandy loam, 5 to 9 percent slopes	7, 300	. 9
Ascalon-Platner association	7, 700	1. 0
Ascalon-Vona sandy loams, 1 to 5 percent slopes	30, 900	4. 0
Blakeland loamy sand, 3 to 9 percent slopes	7, 000	. 9
Blakeland-Truckton association	12, 600	1. 6
Colby loam, 5 to 20 percent slopes	17, 100	2. 2
Dacono loam, 0 to 1 percent slopes	3, 100	. 4
Dacono loam, 1 to 3 percent slopes	400	(1)
Gravelly land-Shale outcrop complex	2, 700	. 3
Gullied land	4, 500	. 6
Heldt clay, 0 to 3 percent slopes	12, 000	1. 3
Heldt clay, 3 to 9 percent slopes	800	. 1
Loamy alluvial land	32, 900	4. 1
Loamy alluvial land, gravelly substratum	2, 700	. 3
Loamy alluvial land, moderately wet	12, 400	1. 5
Nunn loam, 0 to 1 percent slopes	3, 500	. 4
Nunn loam, 1 to 3 percent slopes	12, 200	1. 6
Nunn clay loam, 0 to 1 percent slopes	3, 200	. 4
Nunn clay loam, 1 to 3 percent slopes	5, 100	. 6
Platner loam, 0 to 3 percent slopes	39, 800	5. 0
Platner loam, 3 to 5 percent slopes	17, 100	2. 1
Renohill loam, 1 to 3 percent slopes	700	. 1
Renohill loam, 3 to 9 percent slopes	8, 400	1. 2
Rough broken land	500	. 1
Samsil clay, 3 to 20 percent slopes	2, 200	. 3
Samsil-Shingle complex, 3 to 35 percent slopes	6, 300	. 8
Sandy alluvial land	12, 400	1. 5
Satanta loam, 0 to 1 percent slopes	1, 100	. 1
Satanta loam, 1 to 3 percent slopes	400	(1)
Shingle-Renohill loams, 5 to 25 percent slopes	9, 100	[illegible]
Stoneham loam, 0 to 3 percent slopes	1, 300	. 2
Stoneham loam, 3 to 9 percent slopes	10, 600	1. 3
Terrace escarpments	2, 300	. 3
Terry fine sandy loam, 0 to 3 percent slopes	800	. 1
Terry fine sandy loam, 3 to 9 percent slopes	4, 100	. 5
Terry-Tassel-Ulm complex, 3 to 20 percent slopes	19, 700	2. 5
Terry-Vona-Tassel complex, 3 to 20 percent slopes	5, 100	. 6
Truckton loamy sand, 0 to 3 percent slopes	10, 500	1. 2
Truckton loamy sand, 3 to 9 percent slopes	20, 800	2. 7
Truckton sandy loam, 1 to 3 percent slopes	14, 000	1. 6
Truckton sandy loam, 3 to 5 percent slopes	2, 800	. 3
Truckton sandy loam, 3 to 9 percent slopes	6, 500	. 8
Ulm loam, 1 to 3 percent slopes	3, 900	. 4
Ulm loam, 3 to 5 percent slopes	11, 400	1. 4
Ulm loam, 5 to 9 percent slopes	5, 200	. 6
Valent loamy sand, 1 to 9 percent slopes	2, 200	. 3
Vona loamy sand, 0 to 3 percent slopes	4, 300	. 5
Vona loamy sand, 3 to 9 percent slopes	15, 700	1. 9
Vona sandy loam, 0 to 1 percent slopes	4, 000	. 5
Vona sandy loam, 1 to 3 percent slopes	3, 400	. 4
Vona sandy loam, 3 to 5 percent slopes	1, 400	. 2
Vona-Ascalon loamy sands, 3 to 9 percent slopes	4, 500	. 6
Weld loam, 1 to 3 percent slopes	103, 500	13. 0
Weld-Deertrail complex, 0 to 3 percent slopes	19, 000	2. 4
Wet alluvial land	4, 000	. 5
Wiley-Adena-Renohill complex, 3 to 20 percent slopes	29, 800	3. 7
Gravel pits	1, 300	. 2
Lakes	3, 700	. 5
Stream channels	3, 400	. 4
Total	800, 500	100. 0

[1] Less than 0.05 percent.

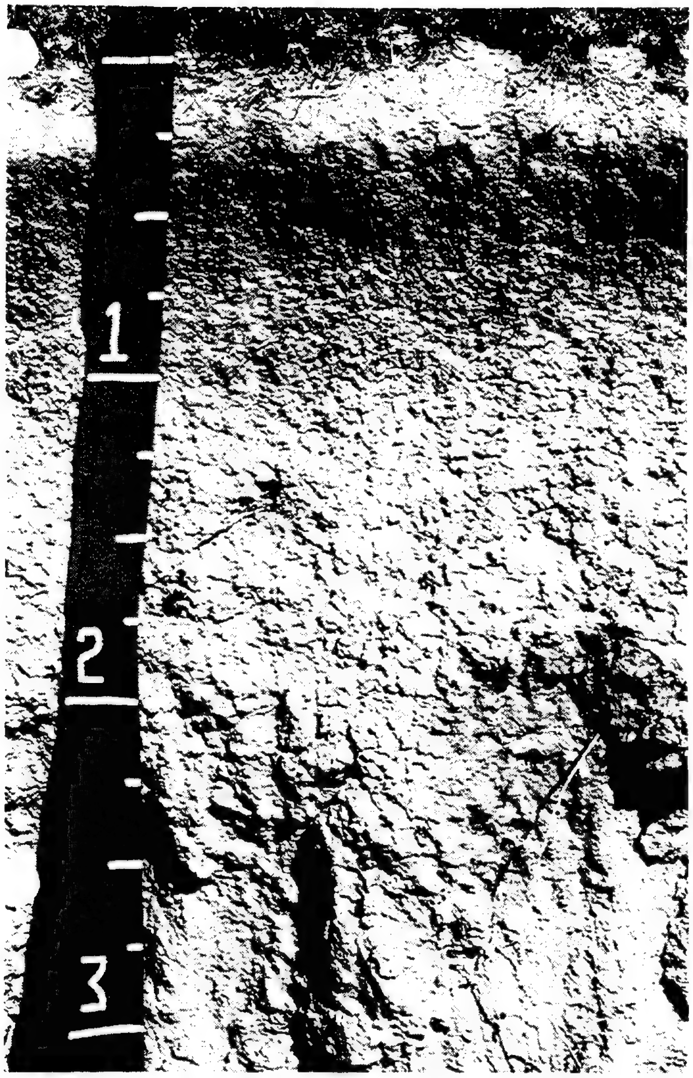

Figure 7.—**Profile of an Adena loam.**

Adena soils absorb water at a moderate rate, and the available water capacity is high. Permeability is slow, and the entire soil is suitable for plant roots.

Representative profile of Adena loam, 3 to 5 percent slopes, in an area of native grass, 25 feet east and 0.3 mile north of the southwest corner of section 6, T. 2 S., R. 57 W.:

A1—0 to 4 inches, grayish-brown (10YR 5/2) loam, dark grayish brown (10YR 4/2) when moist; weak, thin, platy structure to weak, fine, granular structure; slightly hard, friable; neutral; abrupt, wavy boundary.

B2t—4 to 7 inches, dark-brown (10YR 4/3) heavy clay loam, dark brown (10YR 3/3) when moist; strong, fine, prismatic structure parting to strong, medium to fine, angular and subangular blocky structure; hard, firm; continuous clay films on both faces of peds; mildly alkaline; clear, smooth boundary.

B3ca—7 to 11 inches, very pale brown (10YR 7/3) silty clay loam, dark brown (10YR 4/3.5) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard, friable; calcareous and contains lime visible as splotches; thin patchy clay films on both faces of peds; moderately alkaline; clear, smooth boundary.

C1ca—11 to 22 inches, very pale brown (10YR 7/3) silty clay loam, dark brown (10YR 3/3) when moist; very weak, medium, prismatic structure parting to medium, coarse, subangular blocky structure; hard, friable; calcareous and contains lime visible as splotches; moderately alkaline; clear, wavy boundary.

C2—22 to 60 inches, light-gray (10YR 7/2) silt loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; calcareous; moderately alkaline.

The A horizon ranges from 2 to 5 inches in thickness and from light grayish brown to dark grayish brown in color. The B2 horizon ranges from neutral to strongly alkaline.

Adena loam, 0 to 3 percent slopes (AaB).—This soil is in the eastern two-thirds of the county. Surface runoff is medium to rapid, and the hazard of water erosion is moderate. Soil blowing is a severe hazard in unprotected areas. Included in mapping are small areas of Weld loam in depressions.

Most areas of this soil are cultivated. Many small scattered areas have a cover of native grass that is used for grazing. Capability unit IVe-3, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Adena loam, 3 to 5 percent slopes (AaC).—This soil has the profile described as representative for the series. Areas of this soil are irregular in shape and range from 20 acres to approximately 60 acres in size. Runoff is rapid, the hazard of water erosion is severe, especially if protective cover is inadequate. Soil blowing is a severe hazard in unprotected areas. Included in mapping are some small areas of Colby soils.

Most areas of this soil are cultivated. Many small scattered areas are under native grass that is grazed. Capability unit IVe-4, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Adena-Colby association, gently sloping (AcC).—This association consists of intermingled Adena, Colby, and Wiley loams. Adena loam, 3 to 5 percent slopes, is the dominant soil and makes up about 40 percent of the association. It normally has slopes facing east and southeast. Colby loam, 3 to 5 percent slopes, makes up about 30 percent of the association. It is on ridgetops and knolls that are more exposed to the wind. Wiley loam is in slightly more sloping areas facing west to north; it forms about 30 percent of the association.

Included in mapping, where the association is dissected by drainageways, are small areas of Loamy alluvial land.

Soils of this mapping unit are suitable for dryfarming if they are carefully managed. They are commonly used for rangeland where they are adjacent to steep Colby soils. Capability unit IVe-4, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Adena-Colby association, moderately sloping (AcD).—This association is similar to Adena-Colby association, gently sloping, but occupies the more rolling parts of the landscape. Also, it has a slightly lower percentage of Adena soil and slightly higher percentage of Colby soil. In addition, the surface layer tends to be thinner and lime is nearer the surface in most areas.

Adena loam makes up about 35 percent of this association, Colby loam about 30 percent, and Wiley loam 25 percent.

Included in mapping are small areas of Loamy alluvial land along narrow drainageways, some areas of slickspots on the more sloping topography, and a few small deposits of gravel that commonly are underlain by a reddish-colored buried soil remnant at depths of 3 to 5 feet. These inclusions make up the remaining 10 percent of the association.

This association is unsuitable for cultivation because of slope and the hazards of soil blowing and water erosion. It is more suitable for grazing. Capability unit VIe-1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Arvada Series

The Arvada series consists of well-drained, nearly level soils on terraces. These soils formed in stratified materials laid down by water.

In a representative profile, the surface layer is light brownish-gray, weakly calcareous loam about 4 inches thick. The upper part of the subsoil is grayish-brown, noncalcareous clay about 4 inches thick. The lower part of the subsoil is light brownish-gray, slightly calcareous clay about 7 inches thick. Small amounts of salt crystals are visible. The underlying material is highly calcareous, salty, stratified, light brownish-gray sandy clay and light-gray sandy loam that extends to a depth of 60 inches.

Arvada soils absorb water slowly, and the available water capacity is very low. Permeability is very slow. Roots are confined mainly to the surface layer. There are few roots below this layer, except for those of alkali-tolerant plants.

Representative profile of Arvada loam, 0 to 3 percent slopes, in an area of grass, 1,200 feet north and 70 feet east of the southwest corner of section 14, T. 2 S., R. 61 W.:

A21—0 to 2 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard, very friable; calcareous; mildly alkaline; abrupt, smooth boundary.

A22—2 to 4 inches, light brownish-gray (10YR 6/2) sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard, very friable; noncalcareous; moderately alkaline; abrupt, smooth boundary.

B2t—4 to 8 inches, grayish-brown (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, columnar structure with rounded tops, parting to moderate, medium, subangular blocky structure; very hard, firm; continuous clay films; noncalcareous; moderately alkaline; gradual, smooth boundary.

B3cacs—8 to 15 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; very hard, firm; thin patchy clay films; calcareous and contains small pockets of gypsum crystals and other visible salts; strongly alkaline; gradual, smooth boundary.

C1cs—15 to 28 inches, light brownish-gray (2.5Y 6/2) sandy clay, dark grayish brown (2.5Y 4/2) when moist; very weak, medium, subangular blocky structure; very hard, firm; calcareous and contains small pockets of gypsum crystals; very strongly alkaline; abrupt, smooth boundary.

IIC2cs—28 to 60 inches, light-gray (5Y 7/2) sandy loam, olive gray (5Y 5/2) when moist; massive; slightly hard, very friable; calcareous and contains numerous pockets of gypsum; strongly alkaline.

The A horizon ranges from 2 to 4 inches in thickness, f light brownish gray to gray in color, and from loam to sandy loam in texture. The B horizon ranges from 6 to 26 inches in thickness.

Arvada loam, 0 to 3 percent slopes (AdB).—This soil is on terraces along the drainageways of most larger streams. Areas of this soil are irregular in shape and range from 10 to 140 acres in size. Surface runoff is medium, and the hazard of water erosion is moderate. Included in mapping are small areas of nearly level Nunn soils. Most areas of this soil are used for grazing. Capability unit VIIs-2, nonirrigated; Salt Flat range site; tree planting suitability group 4.

Ascalon Series

The Ascalon series consists of well-drained, nearly level to moderately sloping soils on uplands. These soils formed in loamy material containing varying amounts of sand and gravel.

In a representative profile, the surface layer is brown sandy loam about 6 inches thick. It is noncalcareous. The upper part of the subsoil is brown sandy loam and sandy clay loam about 15 inches thick. It is noncalcareous. The lower part of the subsoil is brown sandy loam about 6 inches thick. It is highly calcareous and contains much visible lime. The underlying material, at a depth of 27 to 60 inches or more, is highly calcareous, pale-brown fine sandy loam and very pale brown sandy loam.

Ascalon soils absorb water at a moderate to rapid rate, and the available water capacity is high. Per ability is moderate, and the entire soil is suitable for plant roots.

Representative profile of Ascalon sandy loam, 1 to 3 percent slopes, in a cultivated field, 0.3 mile west and 100 feet north of the southeast corner of section 10, T. 1 S., R. 65 W.:

Ap—0 to 6 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 3/3) when moist; weak, fine, granular structure; soft, very friable; noncalcareous; neutral; abrupt, smooth boundary.

B1—6 to 10 inches, brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; moderate, coarse, subangular blocky structure; hard, firm; very thin patchy clay films on all ped faces; noncalcareous; neutral; clear, smooth boundary.

B2t—10 to 21 inches, brown (10YR 4/3) sandy clay loam, dark brown (10YR 3/3) when moist; moderate to strong, medium, prismatic structure parting to moderate, medium, angular and subangular blocky structure; very hard, firm; thin clay films on all ped faces; noncalcareous; neutral; clear, smooth boundary.

B3ca—21 to 27 inches, brown (10YR 5/3) sandy loam, brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; very hard, friable; thin patchy clay films on all ped faces; calcareous, lime disseminated and in splotches; moderately alkaline; clear, smooth boundary.

C1ca—27 to 34 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; hard, very friable; calcareous, moderate lime accumulation, visible lime in finely divided forms; moderately alkaline; clear, wavy boundary.

C2ca—34 to 60 inches, very pale brown (10YR 7/3) sandy loam, pale brown (10YR 6/3) when moist; mas

hard, very friable; calcareous and contains visible lime in finely divided forms and streaks; strongly alkaline.

The A horizon ranges from 3 to 10 inches in thickness, from grayish brown to brown in color, and from sandy loam to loamy sand in texture. The B2 horizon varies in thickness on different slopes; it ranges from 10 to 30 inches in thickness and from brown to dark brown in color.

Ascalon loamy sand, 0 to 3 percent slopes (ArB).—This soil has a profile similar to the one described as representative for the series, but it has a loamy sand surface layer 3 to 10 inches thick. Runoff is slow, and the hazard of water erosion is slight to moderate. Soil blowing is a severe hazard.

This soil is used for irrigated and dryfarmed crops. Capability unit IIIe-5, irrigated, and IVe-9, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Ascalon loamy sand, 3 to 5 percent slopes (ArC).—This soil has a profile similar to the one described as representative for the series, but it has a thinner surface layer and subsoil. Runoff is slow to medium, and the hazard of water erosion is moderate. Soil blowing is a severe hazard.

Included in mapping, near drainageways, are a few small areas of Vona loamy sand, 3 to 9 percent slopes, and Stoneham loam, 3 to 9 percent slopes.

This soil is mostly dryfarmed. Some areas are in native grass. Many old fields have been reseeded to grass mixtures. Capability unit IVe-7, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Ascalon sandy loam, 1 to 3 percent slopes (AsB).—This soil has the profile described as representative for the series. It is on upland ridges and benches. Areas are generally irregular in shape and range from 40 acres to 400 acres in size. Surface runoff is slow to medium, and the hazard of water erosion is slight to moderate. Soil blowing is a severe hazard in unprotected areas.

Included in mapping are small areas of Vona sandy loam on slightly steeper ridges. Also included are a few potholes, or small beds of intermittent lakes, that are scattered throughout.

Most areas of this soil are or have been cultivated. A few areas remain in grass, and a few formerly cultivated fields have been reseeded to grass mixtures. Capability unit IIe-2, irrigated, and IIIe-7, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Ascalon sandy loam, 3 to 5 percent slopes (AsC).—This soil is in areas adjacent to the major streams of the county, but it is only on the higher upland ridges and side slopes. The areas are longer from south to north than from east to west because they follow the drainage pattern. This soil has a profile similar to the one described as representative for the series, but it has a thinner surface layer and subsoil. Surface runoff is medium, and the hazard of water erosion is moderate. Soil blowing is severe, especially if fields are left unprotected.

Included in mapping are small areas of Vona sandy loam that occupy the more sloping areas.

Most areas of this soil are or have been cultivated, but some areas have a cover of native grass. Capability unit IIIe-3, irrigated, and IVe-7, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Ascalon sandy loam, 5 to 9 percent slopes (AsD).—This soil is on uplands near the edges of the breaks adjacent to stream channels. This soil has a profile similar to the one described as representative for the series, but it has a much thinner surface layer and subsoil. The surface layer ranges from 3 to 6 inches in thickness, and the subsoil from 6 to 14 inches. Interbedded sandstone and shale are at a depth of 4 or 5 feet in some areas.

Included in mapping are a few scattered areas of Vona loamy sand and Stoneham loam near the steep sandy breaks areas.

Much of this soil is cultivated and used for either dry farming or irrigated farming, depending on the area in the county where irrigation water is available. This is good native rangeland. Capability unit IVe-2, irrigated, and IVe-6, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Ascalon-Platner association (At).—Ascalon sandy loam, 3 to 5 percent slopes, makes up about 60 percent of this association and occupies the more sloping areas. Platner loam, 0 to 3 percent slopes, makes up about 40 percent and is in the lower lying or depressional areas. Some drainages pass through the association, but others are blocked and form the beds of small intermittent lakes.

Most areas of this association are cultivated and dryfarmed. Small blowouts are commonly on the highest ridge points and in some field corners. These soils also are used for grazing. Ascalon sandy loam, capability unit IVe-7, nonirrigated; Sandy Plains range site; tree planting suitability group 2. Platner loam, capability unit IIIc-1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Ascalon-Vona sandy loams, 1 to 5 percent slopes (AvC).—Ascalon sandy loam, 1 to 3 percent slopes, makes up 45 percent of this complex and occupies the smoother and lower lying areas. Vona sandy loam, 3 to 5 percent slopes, makes up 35 percent and normally is in the more sloping parts of the landscape.

Included in mapping are small areas of Ascalon loamy sand and Vona loamy sand, which make up the remaining 20 percent.

Most areas of this complex are cultivated and dryfarmed. Some areas are used for grazing. A few small blowouts are on the higher ridge points. The major crops are small grains and feed for livestock. Capability unit IVe-7, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Blakeland Series

The Blakeland series consists of somewhat excessively drained, gently sloping to moderately sloping soils on uplands. These soils formed in wind- and water-worked sandy material.

In a representative profile, the surface layer is grayish-brown loamy sand about 5 inches thick. It is noncalcareous. The next layer is brown sandy loam, about 4 inches thick, that is noncalcareous. The underlying material, from a depth of about 9 inches to 60 inches or more, is noncalcareous, brown loamy sand and pale-brown sand.

Blakeland soils absorb water rapidly, and the available water capacity is low. The entire profile becomes un-

usually hard as it dries. When dry, these soils hold a nearly vertical bank. Permeability is rapid, and the entire soil is suitable for plant roots.

Representative profile of Blakeland loamy sand, 3 to 9 percent slopes, in an area of grass, 1,000 feet south and 30 feet west of the northeast corner of section 2, T. 1 S., R. 59 W.:

A1—0 to 5 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; weak, fine, granular structure; slightly hard, very friable; neutral; clear, smooth boundary.

AC—5 to 9 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 3/3) when moist; very weak, medium, subangular blocky structure; very hard, very friable; neutral; clear, smooth boundary.

C1—9 to 15 inches, brown (10YR 5/3) loamy sand, dark brown (10YR 4/3) when moist; massive; very hard, friable; neutral; gradual, smooth boundary.

C2—15 to 60 inches, pale-brown (10YR 6/3) sand, dark brown (10YR 4/3) when moist; massive; hard, friable; neutral; gradual, smooth boundary.

The A horizon ranges from about 5 to 9 inches in thickness and from grayish brown to dark grayish brown in color.

Blakeland loamy sand, 3 to 9 percent slopes (BoD).—This soil is on uplands. It has the profile described as representative for the series. Surface runoff is medium to slow. The hazard of soil blowing is severe. Most areas of this soil are used for range or are in old cultivated fields that have been reseeded to grass. The soil is not suitable for cultivation. Capability unit VIe-5, nonirrigated; Deep Sand range site; tree planting suitability group 3.

Blakeland-Truckton association (Bt).—Blakeland loamy sand, 3 to 9 percent slopes, makes up at least 60 percent of this association. It is generally in areas of semidune relief, though it also is on long, narrow ridges. Truckton loamy sand, 3 to 9 percent slopes, makes up 20 to 40 percent of mapped areas. It is depressional or has the more gentle slopes.

Included in mapping are some small areas of Valent loamy sand and Loamy alluvial land.

The hazard of soil blowing generally is moderate, but it is very severe in places if adequate cover is not maintained. Small areas have been severely affected by soil blowing, and small blowouts have formed in places.

This association is used for rangeland and was mapped only in areas that exceed 100 acres in size. Consequently, all areas have a cover of native grass. The soils are not suitable for cultivation. Capability unit VIe-5, nonirrigated; Deep Sand range site; tree planting suitability group 3.

Colby Series

The Colby series consists of well-drained, moderately sloping to strongly sloping soils on uplands. These soils formed in wind-deposited loamy material.

In a representative profile, the surface layer is brown loam about 5 inches thick. It is calcareous. The next layer is pale-brown, highly calcareous loam about 8 inches thick. This is underlain, to a depth of about 56 inches, by pale-brown, highly calcareous loam. Between depths of 56 to 60 inches is light yellowish-brown, highly calcareous sandy clay loam.

Colby soils absorb water at a moderate rate, and the available water capacity is high. Permeability is m erate, and the entire soil is suitable for plant roots.

Representative profile of Colby loam, 5 to 20 percent slopes, in a cultivated field, 300 feet south and 190 feet west of northeast corner of section 36, T. 3 S., R. 66 W.:

Ap—0 to 5 inches, brown (10YR 5/3) loam, dark brown (10YR 4/3) when moist; very weak subangular blocky structure parting to weak, fine, granular structure; soft, very friable; calcareous; moderately alkaline; abrupt, smooth boundary.

C1ca—5 to 13 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3.5) when moist; weak, coarse, subangular blocky structure; slightly hard, friable; calcareous and contains lime disseminated and in streaks and splotches; moderately alkaline; clear, smooth boundary.

C2—13 to 48 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

C3—48 to 56 inches, pale-brown (10YR 6/3) fine sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; calcareous; moderately alkaline; abrupt, smooth boundary.

IIC4—56 to 60 inches, light yellowish-brown (10YR 6/4) sandy clay loam, yellowish brown (10YR 5/4) when moist; massive; hard, firm; calcareous; moderately alkaline.

The A horizon ranges from loam to very fine sandy loam, from 3 to 5 inches in thickness, and from grayish brown to brown in color. The IIC horizon is absent in some places.

Colby loam, 5 to 20 percent slopes (CbE).—This soil is on uplands. The areas are irregular in shape and range from a few acres to about 100 acres in size. Surface runoff is rapid, and the hazards of soil blowing and wat-- erosion are severe in unprotected areas. Included in m ping are some small areas of Adena loam.

About half the acreage of this soil is cultivated, and about half is in grass. The cultivated areas are mostly part of large farming operations and are farmed with larger areas of Adena and Weld soils. Many old fields have been abandoned and reseeded to grass. Capability unit VIe-2, nonirrigated; Loamy Slopes range site; tree planting suitability group 1.

Dacono Series

The Dacono series consists of well-drained, nearly level soils on terraces. These soils formed in loamy alluvium that overlies sandy and gravelly alluvial materials.

In a representative profile, the surface layer is grayish-brown and dark grayish-brown loam about 9 inches thick. It is noncalcareous. The upper part of the subsoil is grayish-brown clay about 8 inches thick. It is noncalcareous. The lower part of the subsoil is light brownish-gray sandy clay loam about 5 inches thick. It is calcareous, and much of the lime is visible as white splotches. The underlying material begins at a depth of about 22 inches. The upper part is calcareous, brown coarse sandy clay loam and coarse loamy sand that contains about 10 percent fine and medium gravel. Below a depth of 35 inches, the underlying material is loose, light-brown sand and gravel.

Dacono soils absorb water slowly, and their available water capacity is moderate. Permeability is slow. The soils are suitable for roots to a depth of about 24 inc

Representative profile of Dacono loam, 0 to 1 percent slopes, in a cultivated field, 0.2 mile south and 155 feet west of the northeast corner of section 13, T. 1 S., R. 67 W.:

Ap1—0 to 5 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, medium, subangular blocky structure parting to moderately fine, granular structure; slightly hard, friable; noncalcareous; neutral; clear, smooth boundary.

Ap2—5 to 9 inches, dark grayish-brown (10YR 4/2) heavy loam, (10 percent fine gravel), very dark grayish brown (10YR 3/2) when moist; weak, moderate, subangular blocky structure; slightly hard, friable; noncalcareous; neutral; clear, smooth boundary.

B2t—9 to 17 inches, grayish-brown (10YR 5/2) clay, dark grayish brown (10YR 4/2) when moist; moderate, medium, prismatic structure parting to strong, fine, angular and subangular blocky structure; moderate continuous clay films on all peds; very hard, firm; noncalcareous; mildly alkaline; clear, wavy boundary.

B3ca—17 to 22 inches, light brownish-gray (10YR 6/2) sandy clay loam, dark grayish brown (10YR 4/2) when moist; weak, medium, subangular blocky structure; hard, very friable; calcareous and contains calcium in splotches and disseminated; moderately alkaline; clear, wavy boundary.

C1—22 to 26 inches, brown (10YR 5/3) coarse sandy clay loam (10 percent fine and medium gravel), dark brown (10YR 4/3) when moist; massive to weak, medium, subangular blocky structure; slightly hard, friable; calcareous; moderately alkaline; clear, wavy boundary.

C2—26 to 35 inches, brown (7.5YR 5/3) very coarse loamy sand (10 percent fine gravel), dark brown (7.5YR 4/3) when moist; massive; hard, very friable; calcareous; moderately alkaline; clear, wavy boundary.

IIC3—35 to 60 inches, light-brown (7.5YR 6/4) sand and gravel, dark brown (7.5YR 4/4) when moist; single grain; loose; calcareous; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness, from grayish brown to dark grayish brown in color, and from loam to clay loam in texture. The B horizon ranges from 8 to 18 inches in thickness. Depth to calcareous material ranges from 8 to 20 inches. Depth to unconsolidated sand and gravel is 20 to 36 inches.

Dacono loam, 0 to 1 percent slopes (DcA).—This soil has the profile described as representative for the series. It contains 5 to 15 percent gravel in the surface layer and subsoil, and it has a sand and gravel layer between depths of 20 and 40 inches. Runoff is slow. The hazard of water erosion is slight, but the hazard of soil blowing is moderate if fields are not protected by crops or residue. Included in mapping are some small areas of Satana loam and a few small gravel spots.

Nearly all of this soil is cultivated and irrigated. The soil is easy to till and is well suited to truck farming (fig. 8). Capability unit IIIs-2, irrigated; not placed in a range site; tree planting suitability group 1.

Dacono loam, 1 to 3 percent slopes (DcB).—This soil has a profile that is similar to the one described as representative for the series, but it has a thinner surface layer and subsoil. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is moderate in unprotected fields.

Most of the soil is cultivated and irrigated. Some of the steeper areas are used for irrigated pasture. Capability unit IIIe-2, irrigated; not placed in a range site; tree planting suitability group 1.

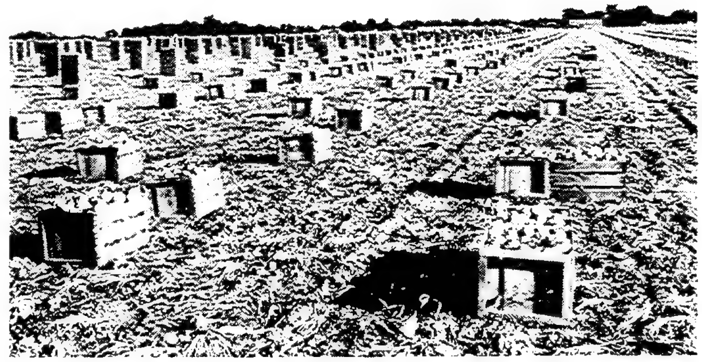

Figure 8.—Intensive truck farming on Dacono soils.

Deertrail Series

The Deertrail series consists of well-drained, nearly level soils on uplands. These soils formed in wind-deposited loamy material. In Adams County, they occur only in a complex with Weld soils.

In a representative profile, the surface layer is light grayish-brown very fine sandy loam and loam about 9 inches thick. It is noncalcareous. The upper part of the subsoil is brown and light brownish-gray clay about 12 inches thick. It is noncalcareous. The lower part of the subsoil is very pale brown silty clay loam about 11 inches thick. It is highly calcareous, and much of the lime is visible as streaks and spots. The underlying material, below a depth of 32 inches, is highly calcareous, very pale brown loam.

Deertrail soils absorb water slowly, and the available water capacity is very low. Permeability is slow. Roots are confined mostly to the surface layer, and only a few roots are in the subsoil.

Representative profile of a Deertrail very fine sandy loam having a slope of less than 1 percent, in an area of grass, 1,800 feet south and 75 feet west of the northeast corner of section 12, T. 3 S., R. 57 W.:

A2—0 to 5 inches, light brownish-gray (10YR 6/2) very fine sandy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, platy structure parting to weak, fine, granular structure; soft, very friable; noncalcareous; neutral; abrupt, smooth boundary.

A&B—5 to 9 inches, light brownish-gray (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, fine, prismatic structure parting to moderate, medium, subangular blocky structure; hard, friable; thin patchy clay films; bleached sand grains on surface of peds; noncalcareous; mildly alkaline; abrupt, smooth boundary.

B21t—9 to 17 inches, brown (10YR 5/3) clay, dark grayish brown (10YR 3.5/2) when moist; strong, medium, columnar structure parting to strong, fine, angular blocky structure; very hard, firm; thin continuous clay films; noncalcareous; moderately alkaline; gradual, smooth boundary.

B22t—17 to 21 inches, light brownish-gray (10YR 6/2) clay, dark grayish brown (10YR 4.5/2) when moist; moderate, medium, prismatic structure parting to moderate to strong, fine, angular and subangular blocky structure; very hard, firm; thin continuous clay films; calcareous; very strongly alkaline; clear, smooth boundary.

B3ca—21 to 32 inches, very pale brown (10YR 7/3) silty clay loam, brown (10YR 5/3) when moist; weak,

fine, prismatic structure parting to moderate, medium and fine, subangular blocky structure; hard, friable; thin patchy clay films; calcareous and contains lime visible as spots and streaks; very strongly alkaline; gradual, smooth boundary.

Cca—32 to 60 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; hard, friable; calcareous and contains lime streaks and spots; very strongly alkaline.

The A horizon ranges from 4 to 9 inches in thickness, from light brownish gray to light gray in color, and from heavy fine sandy loam to loam in texture. The B horizon ranges from 12 to 24 inches in thickness.

Gravelly Land-Shale Outcrop Complex

Gravelly land-Shale outcrop complex (Gr) consists of steep, very steep, and hilly land types. The areas are irregular in shape, but generally they are elongated, extending in a north and south direction, and are roughly parallel to the river channels. The areas range from 20 to 300 acres in size.

The complex consists of very shallow, clayey soils and raw shale that are overlain by a discontinuous layer of gravel deposits 4 inches to many feet thick. These deposits are old enough that some soil is forming in places within the gravelly cap layer. Little if any soil is forming in the shaly exposed areas, much of which is eroding by moderate soil blowing and water action. Some areas contain steep colluvium of mixed materials.

Most of this complex is unsuitable for any farm use except limited grazing in selected areas. A sparse stand of western wheatgrass and blue grama covers some of the least eroded shaly soils, and blue grama, sand dropseed, Indian ricegrass, and some little bluestem are in the gravelly areas. Saltbush is in some places. Some areas that contain steep colluvium are used to produce hay if irrigation water is available. All of this complex is subject to severe erosion.

Some areas of this complex are being developed for homesites, but care should be used in construction because of the high shrink-swell properties (bentonitic) of some of the shale materials. Also present are corrosive salts that, with an addition of water, set up hydrolysis conditions that can destroy buried metal pipe. The high shrink-swell properties are hazardous to foundations, street locations, and all concrete or brick structures. The best building sites are in areas that contain the thickest layers of gravel. Certain areas provide fair to good locations for sand and gravel pits, but the supply in most places is limited. Capability unit VIIs–5, nonirrigated; tree planting suitability group 4. Gravelly land, Gravel Breaks range site. Shale outcrop, Shale Breaks range site.

Gullied Land

Gullied land (Gu) is in steeper upland swales throughout the county. The areas are elongated in shape and follow the swales. Although they can extend in any direction, most of them extend down the swale in westerly, northwesterly, and northerly directions. The areas range from 40 to 400 acres in size.

Areas mapped as this land type contain only a few inclusions, for generally the areas appear as gullied spots in the landscape. A few small areas of Samsil and Shingle soils are between the more severely eroded gullied areas.

Gullied land was formed by concentrated runoff that progressed down the swales when little or no vegetation was on the surface. Headcuts started at the lower end of the swales, generally in shaly soils, then progressed up the swale through interbedded shale and soft sandstone. Eventually the gullying extended into the higher lying silty mantle, where it became much more rapid and widespread.

Natural revegetation has started in some protected areas where diversion dikes have been built or where the overlying silty soils have been kept out of cultivation. Native grasses are healing the scars, but Gullied land is steep and rough, and it still shows evidence of some erosion, mostly slips or catsteps. Among the grasses taking over are western wheatgrass, blue grama, sideoats grama, sacaton, and little bluestem.

Potentially, this land type is most suitable as grassland. The hazard of water erosion is severe, and that of soil blowing is moderate to severe. Capability unit VIIe–1, nonirrigated; not placed in a range site; tree planting suitability group 4.

Heldt Series

The Heldt series consists of well-drained, nearly level to moderately sloping soils on terraces. These soils formed in clayey alluvial material.

In a representative profile, the surface layer is light brownish-gray clay about 5 inches thick. It is noncalcareous. The subsoil is light brownish-gray clay about 27 inches thick. It is noncalcareous in the upper 9 inches and slightly calcareous in the lower part. Also, a few spots and streaks of salt are visible in the lower part. The underlying material, below a depth of 32 inches, is light-gray and light brownish-gray silty clay loam in the upper part and very pale brown sandy clay loam and sandy loam in the lower part. It extends to a depth of 60 inches and is slightly calcareous.

Heldt soils absorb water rapidly when dry because of the large cracks, but as the soil swells, water absorption becomes very slow. The available water capacity is high. Permeability is slow, and the entire soil is suitable for plant roots.

Representative profile of Heldt clay, 0 to 3 percent slopes, in a cultivated field, 0.3 mile north and 40 feet east of the southwest corner of section 36, T. 2 S., R. 61 W.:

Ap—0 to 5 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; blocky or thick platy structure parting to moderate, medium and fine, granular structure; hard, firm; noncalcareous; moderately alkaline; clear, smooth boundary.

B21—5 to 14 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic and subangular pressure faces or slickensides; cracks are more than 1 centimeter wide; very hard, very firm; noncalcareous; moderately alkaline; clear, smooth boundary.

B22—14 to 22 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, coarse, prismatic and subangular blocky structure; extremely hard, very firm; pressure faces or slickensides; calcareous; moderately alkaline; gra smooth boundary.

B3—22 to 32 inches, light brownish-gray (2.5Y 6/2) clay, dark grayish brown (2.5Y 4/2) when moist; weak, medium, subangular blocky structure; extremely hard, very firm; pressure faces or slickensides; salt spots and streaks; calcareous; moderately alkaline; gradual, smooth boundary.

C—32 to 40 inches, light-gray (2.5Y 7/2) and light brownish-gray (2.5Y 6/2) silty clay loam, light brownish gray (2.5Y 6/2) and grayish brown (2.5Y 5/2) when moist; very weak, medium, subangular blocky structure; hard, firm; calcareous; moderately alkaline; clear, smooth boundary.

IIC2—40 to 60 inches, very pale brown (10YR 7/3) sandy clay loam, brown (10YR 5/3) when moist, stratified with very pale brown (10YR 8/3 or 7/3) sandy loam, brown and pale brown (10YR 6/3) when moist; massive; hard, friable; calcareous; moderately alkaline.

The A horizon ranges from 3 to 7 inches in thickness, from gray to light brownish gray in color, and from clay to clay loam in texture. The B horizon ranges from 16 to 30 inches in thickness.

Heldt clay, 0 to 3 percent slopes (HB).—This soil has the profile described as representative for the series. It is on terraces along some of the major streams in the county. Surface runoff is medium to slow, and the hazard of water erosion is slight. Included in mapping are small areas of Nunn loam and Arvada loam. Most areas of this soil are cultivated and irrigated (fig. 9). Capability unit IIIs-1, irrigated, and IVs-3, nonirrigated; Clayey Plains range site; tree planting suitability group 4.

Heldt clay, 3 to 9 percent slopes (HD).—This soil is on terraces and benches along most of the major drainageways in the county. The areas are long and narrow and are parallel to streams. Surface runoff is medium to rapid, and the hazard of water erosion is moderate to severe. The hazard of soil blowing is slight. In places this soil is underlain by sand or sand and gravel below a depth of 40 inches, and these areas are subject to streambank cutting from floods or fluctuating streamflow. Near the steeper edges of drainageways, this soil is subject to gullying when the flow of water is concentrated. This soil has a profile similar to the one described as representative for the series, but it has a thinner surface layer. Because it is steeper and more erodible, this soil is more difficult to farm than the less sloping Heldt soil.

Included in mapping, in some areas, are small areas of sandy deposits and a few areas of steeper, clayey soils on terrace edges or old cutbanks.

Some areas of this Heldt soil have been used for dry farming, but most areas have been reseeded to grass. Under irrigation, some of the more gently sloping areas can be used for alfalfa and pasture grasses. Capability unit IVe-1, irrigated, and VIe-3, nonirrigated; Clayey Plains range site; tree planting suitability group 4.

Loamy Alluvial Land

Loamy alluvial land is mapped in three units in Adams County—Loamy alluvial land; Loamy alluvial land, gravelly substream; and Loamy alluvial land, moderately wet.

Loamy alluvial land (Lu) is in drainageways throughout the county. It is mainly in the long drainageways within areas of deep silty deposits in the eastern half of the

Figure 9.—Sugar beets growing on Heldt soils. Irrigation water must be applied carefully.

county. Slopes are less than 3 percent. Some areas are broad in the larger and more gently sloping drainageways, such as the Badger, San Arroyo, and Muddy Creeks, and in places on the South Platte River. All are subject, in varying degrees, to flooding from adjacent slopes and main stream channels. Included in mapping are small areas of Satanta loam, Nunn loam, and Sandy alluvial land and some very small areas of Wet alluvial land.

The surface layer is commonly dark-colored loam or clay loam about 6 to 10 inches thick. It is normally noncalcareous. In places sandier materials have been deposited unevenly on the surface by floodwaters. The underlying material is stratified loam, silt loam, and clay loam and contains varying amounts of fine sand, sand, and fine gravel. It is 20 to more than 60 inches thick, is brown to dark brown, and in places has weak structure. It is normally calcareous. Sand or sand and gravel, stratified with thin lenses of silt and loam, are in some places below a depth of 36 inches.

The soils of this land type absorb water at a moderate rate, and their available water capacity is high. They are normally well drained. Natural fertility is high. The surface layer is easy to work, but the hazard of water erosion is very severe in all cultivated areas because gullies form easily if fields are not protected from flooding. Broad areas, more than 200 feet wide, are suitable for dryland cultivation and are less subject to gully erosion.

Most of this land type is in native grass or in pasture that has been improved by the use of check dams and water spreading. Native grasses include western wheatgrass, blue grama, and switchgrass. A few areas of suitable size are used to produce winter wheat, barley, and forage sorghums. Capability unit VIe–1, nonirrigated; Overflow range site; tree planting suitability group 5.

Loamy alluvial land, gravelly substratum (Lv) occurs as small areas in major drainageways. It is a principal source of gravel. Nearly all areas are subject to flooding from streams, and the floods often are damaging.

The soils are shallow and stratified. The strata are of moderately coarse textured to moderately fine textured material that is underlain by river sand and gravel. In some places the soils are slightly influenced by soluble salts.

The soils of this land type absorb water at a rapid to slow rate. The available water capacity is low, but many areas have a high water table that is beneficial to plant growth.

Much of this land type is cultivated and irrigated. The principal crops are truck crops adapted to the area, mainly celery, melons, sweet corn, tomatoes, lettuce, carrots, onions, and cabbage. The best growing conditions can be maintained if the normal water table is controlled so that it remains at a depth of 10 to 20 inches below the surface during the growing season. Other irrigated crops include pasture mixtures that require some irrigation but are partly sustained by the water table in the gravel layers.

Some of this land type is in native grass, mainly western wheatgrass, saltgrass, blue grama, and switchgrass. The wetter areas produce sedges, rushes, and cattails. This vegetation is largely sustained by the natural water table and by flooding. Little irrigation is needed. Capability unit IVw–1, irrigated; not placed in a range site; tree planting suitability group 5.

Loamy alluvial land, moderately wet (Lw) is in ma drainageways throughout the county. It is predominantly in the broader drainageways that have a high water table and that formerly had poor drainage. The areas are broad in the larger and more gently sloping drainageways, especially in the South Platte River bottom. All are subject to damage, in varying degrees, by flooding from adjacent slopes and main stream channels. Included in mapping are small areas of Nunn loam, Satanta loam, Wet alluvial land, and Loamy alluvial land, gravelly substratum.

The soils are moderately deep, ranging from 20 to 36 inches in depth, over unconsolidated sand and gravel. They are dark-colored loam to clay loam in texture and generally are stratified. They are normally noncalcareous, but they are moderately influenced by soluble salts in places. Thin lenses of sand, silt, or fine gravel may be in any of the layers.

The soils of this land type absorb water at a moderate to slow rate, and the available water capacity is high. Artificial drainage is generally needed to grow crops. Natural fertility is high, but under the intensive management used on these soils, artificial supplements are needed.

Most of this land type is irrigated. In these areas, crops such as sugar beets, corn, small grains, and vegetables can be grown. Alfalfa and irrigated pasture are well adapted. Western wheatgrass, saltgrass, blue grama, and switchgrass are grown in some areas. Capability unit IIIw–1, irrigated; not placed in a range site; tree planting suitability group 5.

Nunn Series

The Nunn series consists of well-drained, nearly level soils on terraces. These soils formed in loamy alluvial material.

In a representative profile, the surface layer is grayish-brown loam about 6 inches thick. It is noncalcareous. The subsoil is dark grayish-brown and grayish-brown clay about 17 inches thick. It is noncalcareous. The underlying material, below a depth of 23 inches, is light yellowish-brown and grayish-brown loam and silt loam. It is highly calcareous and stratified.

Nunn soils absorb water at a moderate rate, and the available water capacity is high. Permeability is slow in Nunn soils that have a clay loam surface layer, and it is moderately slow in those that have a loam surface layer. The entire soil is suitable for plant roots.

Representative profile of Nunn loam, 1 to 3 percent slopes, in an area of grass, 1,500 feet east and 2,540 feet north of the southwest corner of section 36, T. 3 S., R. 65 W.:

A1—0 to 6 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist and crushed; weak, fine, granular structure; friable; noncalcareous; neutral; clear, smooth boundary.

B1—6 to 9 inches, dark grayish-brown (10YR 4/2) light clay loam, very dark grayish brown (10YR 3/2) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; slightly hard, friable; thin patchy clay films on all fac of peds; noncalcareous; neutral; clear, smooth boun

B21t—9 to 18 inches, dark grayish-brown (10YR 4/2) clay, very dark grayish brown (10YR 3/2) when moist; moderate, medium, prismatic structure parting to moderate to strong, medium, subangular blocky structure; very hard, firm; continuous clay films; noncalcareous; mildly alkaline; clear, smooth boundary.

B22t—18 to 23 inches, grayish-brown (10YR 5/2) clay, dark brown (10YR 4/3) when moist; moderate to strong, medium, prismatic structure parting to strong, medium, angular and subangular blocky structure; very hard, firm; continuous clay films on all peds; noncalcareous; mildly alkaline; clear, smooth boundary.

C1ca—23 to 44 inches, light yellowish-brown (10YR 6/4) loam, dark yellowish brown (10YR 4/4) when moist; massive; very hard, friable; calcareous and contains lime disseminated and lime mycelia visible; moderately alkaline; gradual, smooth boundary.

C2ca—44 to 60 inches, grayish-brown (10YR 5/2) silt loam, dark grayish brown (10YR 4/2) when moist; massive; hard, friable; calcareous and contains lime mycelia; moderately alkaline. (This layer is variable, contains sandy lenses, and in places shows evidence of former poor drainage and stratification typical of old alluvium).

The A horizon ranges from 4 to 8 inches in thickness, from grayish brown to dark grayish brown in color and from heavy fine sandy loam to clay loam in texture. The B horizon ranges from 10 to 30 inches in thickness. Some areas have gravel and sand below a depth of 40 inches.

Nunn loam, 0 to 1 percent slopes (NlA).—This soil is on stream terraces along most of the major drainageways in the county. The areas are irregular in shape and range from about 10 acres to 100 acres in size. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate in cultivated fields without protective cover. This soil has a profile similar to the one described as representative for the ies, but it has a thicker surface layer and subsoil and is less susceptible to erosion. Included in mapping are small areas of Satanta and Dacono soils and Loamy alluvial land.

All of this soil is cultivated and irrigated. It is easy to work and is well suited to all adapted crops. Capability unit I–1, irrigated; not placed in a range site; tree planting suitability group 1.

Nunn loam, 1 to 3 percent slopes (NlB).—This soil has the profile described as representative for the series. It is on old stream terraces. The areas are irregular in shape and range from 10 acres to 80 acres in size. Surface runoff is medium, and the hazard of erosion is slight to moderate. In places concentrations of runoff can cause gullying in unprotected fields. In some areas, stream overflow is a hazard to growing crops because of washing and silt deposition. Included in mapping are small areas of Satanta and Dacono soils and very small areas of Heldt soils.

Most areas of this soil are cultivated, and many are irrigated. Some areas are dryfarmed, and some are in native grass. Capability unit IIe–1, irrigated, and IIIe–1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Nunn clay loam, 0 to 1 percent slopes (NuA).—This soil is on river terraces throughout most of the county. The areas are irregular in shape and tend to be longer north and south than east and west. Runoff is slow, and the hazard of water erosion is slight. Included in mapping are small areas of Satanta and Heldt soils. . . of this soil is cultivated and irrigated. Capability unit IIs–1, irrigated; not placed in a range site; tree planting suitability group 1.

Nunn clay loam, 1 to 3 percent slopes (NuB).—This soil is on stream terraces along major streams of the county. The areas are long and narrow and roughly parallel to stream channels. Runoff is medium, and the hazard of water erosion is moderate. Soil blowing can be controlled by providing adequate cover. This soil has a profile similar to the one described as representative for the series, but it has a more clayey surface layer and a thinner subsoil.

Most areas of this soil are cultivated, and many are irrigated. Some areas are dryfarmed, and some are in native grass and used for grazing. Capability unit IIe–1, irrigated, and IIIs–3, nonirrigated; Clayey Plains range site; tree planting suitability group 1.

Platner Series

The Platner series consists of well-drained, nearly level to gently sloping soils on uplands. These soils formed in old alluvium.

In a representative profile, the surface layer is grayish-brown loam about 9 inches thick. It is noncalcareous. The upper part of the subsoil is brown clay about 9 inches thick. It is noncalcareous. The lower part of the subsoil is light-gray clay loam about 10 inches thick. It is highly calcareous, and part of the lime is visible as splotches. The underlying material, below a depth of 28 inches, is very pale brown loam that is highly calcareous. At a depth of about 49 inches, it is a white and very pale brown sandy loam that is highly calcareous and contains some fine gravel.

Platner soils absorb water slowly, and the available water capacity is high. Permeability is slow, and the entire soil is suitable for plant roots.

Representative profile of Platner loam, 0 to 3 percent slopes, in a cultivated field, 2,500 feet east and 155 feet south of the northwest corner of section 29, T. 2 S., R. 68 W.:

Ap—0 to 9 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/3) when moist; moderate, medium, granular structure; slightly hard, friable; noncalcareous; neutral; abrupt, smooth boundary.

B2t—9 to 18 inches, brown (10YR 5/3) clay, dark brown (10YR 3/3) when moist; strong, medium, prismatic structure parting to strong, medium and fine, angular and subangular blocky structure; very hard, firm; continuous clay films on all ped faces; noncalcareous; neutral; gradual, smooth boundary.

B3ca—18 to 28 inches, light-gray (10YR 7/2) clay loam, light brownish gray (10YR 6/2) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; very hard, firm; thin patchy clay films on faces of peds; calcareous and contains calcium disseminated and in splotches; moderately alkaline; gradual, smooth boundary.

C1ca—28 to 49 inches, very pale (10YR 7/3) loam, light yellowish brown (10YR 6/4) when moist; massive; hard, friable; calcareous and contains lime disseminated and in splotches; moderately alkaline; gradual, wavy boundary.

C2ca—49 to 60 inches, white (10YR 8/2) and very pale brown (10YR 7/3) sandy loam, very pale brown (10YR 7/3) when moist; massive; slightly hard, friable; some scattered fine gravel; moderate to strong calcic horizon with lime mostly disseminated; calcareous; strongly alkaline.

The A horizon ranges from 4 to 10 inches in thickness, from grayish brown to dark grayish brown in color, and from sandy loam to light clay loam in texture. The B horizon ranges from 10 to 36 inches in thickness.

Platner loam, 0 to 3 percent slopes (PIB).—This soil has the profile described as representative for the series. It is on uplands. Areas are irregular in shape and range from 20 acres to 300 acres in size. Surface runoff is slow, and the hazard of water erosion is moderate to slight. The hazard of soil blowing is severe in dryfarmed areas unless the soil is protected by growing plants or stubble. Included in mapping are small areas of Weld and Ulm soils having slopes of 1 to 3 percent.

Most areas of this soil are cultivated. A few scattered areas throughout the county are in native grass. A large area is irrigated. Capability unit IIe-1, irrigated, and IIIc-1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Platner loam, 3 to 5 percent slopes (PIC).—This soil is on uplands. It has a profile similar to the one described as representative for the series, but the surface layer and subsoil are thinner. The areas are irregular in shape and range from 10 acres to 60 acres in size. Surface runoff is medium, and the hazard of water erosion is moderate. Included in mapping are small areas of Adena, Ascalon, Colby, and Stoneham soils having slopes of 3 to 5 percent.

Most areas of this soil are cultivated, and some are irrigated. A few scattered areas throughout the county are in native grass. Capability unit IIIe-1, irrigated, and IIIe-6, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Renohill Series

The Renohill series consists of well-drained, nearly level to moderately sloping soils on uplands. These soils formed in loamy material underlain by shaly bedrock at a depth of 20 to 36 inches.

In a representative profile, the surface layer is grayish-brown loam about 4 inches thick. It is noncalcareous. The upper part of the subsoil is light yellowish-brown clay loam and clay about 13 inches thick. It is noncalcareous. The lower part of the subsoil is grayish-brown clay about 6 inches thick. It is highly calcareous, and some lime is visible as spots. The underlying material is white and light yellowish-brown clay loam. It is highly calcareous, and some lime is visible as splotches. At a depth of about 28 inches is shaly bedrock.

Renohill soils absorb water slowly, and the available water capacity is moderate. Permeability is slow. The soil is suitable for plant roots to a depth of about 28 inches.

Representative profile of Renohill loam, 3 to 9 percent slopes, in an area of grass, 2,350 feet east and 0.15 mile south of the northwest corner of section 6, T. 1 S., R. 68 W.:

A1—0 to 4 inches, grayish-brown (2.5Y 5/2) loam, dark grayish brown (2.5Y 4/2) when moist; weak, medium, platy structure parting to weak, medium and fine, granular structure; soft, friable; noncalcareous; mildly alkaline; clear, smooth boundary.

B1—4 to 9 inches, light yellowish-brown (2.5Y 6/3) clay loam, olive brown (2.5Y 4/3) when moist; weak to moderate, coarse, prismatic structure parting to weak to moderate, medium to fine, subangular blocky structure; hard, firm; thin patchy clay films; noncalcareous; moderately alkaline; clear, smooth boundary.

B2t—9 to 17 inches, light yellowish-brown (2.5Y 6/4) clay, olive brown (2.5Y 4/4) when moist; moderate, medium, prismatic structure parting to weak, medium, subangular blocky structure; very hard, firm; films on faces of peds; noncalcareous; moderately alkaline; gradual, smooth boundary.

B3ca—17 to 23 inches, grayish-brown (2.5Y 5/2) clay, grayish brown (2.5Y 5/2) when moist; moderate, medium, prismatic structure parting to moderate, medium, angular and subangular blocky structure; very hard, firm; thin nearly continuous clay films on faces of peds; calcareous and contains lime disseminated and in spots; moderately alkaline; gradual, smooth boundary.

Cca—23 to 28 inches, white (10YR 8/2) and light yellowish-brown (10YR 6/4) clay loam, white (10YR 8/2) and yellowish brown, (10YR 5/4) when moist; massive to weak blocky structure; hard, friable; calcareous and contains lime disseminated and in splotches; strongly alkaline; clear, wavy boundary.

R—28 inches, unweathered interbedded shales and shaly sandstones; calcareous; strongly alkaline.

The A horizon ranges from 2 to 6 inches in thickness, from grayish brown to very pale brown in color, and from very fine sandy loam to light clay loam in texture. The B horizon ranges from about 8 to 30 inches in thickness. Depth to bedrock ranges from 20 to 36 inches.

Renohill loam, 1 to 3 percent slopes (ReB).—This soil is in areas that are irregular in shape and range from 15 to 60 acres in size. Surface runoff is medium, and the hazard of water erosion is moderate. Soil blowing is a moderate hazard on unprotected fields. This soil has a profile similar to the one described as representative for the series, but the surface layer and subsoil are thicker. Included in mapping are small areas of U soils in depressions.

This soil is mostly cultivated and dryfarmed. It is not irrigated in Adams County. Some areas have a cover of grass. Capability unit IVe-3, nonirrigated; Loamy Plains range site; tree planting suitability group 3.

Renohill loam, 3 to 9 percent slopes (ReD).—This soil has the profile described as representative for the series. It is on uplands. The areas are irregular in shape and range from 20 acres to 100 acres in size. Surface runoff is medium to rapid, and the hazards of water erosion and soil blowing are severe in unprotected areas.

Included in mapping are a few small areas of Terry soils on the sharper ridges. Small areas of Shingle and Samsil soils also are included.

Much of this soil is cultivated, and about half of it is irrigated. It is suited to alfalfa and grain if irrigated. In dryfarmed areas small grain is grown if rainfall is sufficient. Some areas of this soil are in native grass. Capability unit IVe-1, irrigated, and VIe-1, nonirrigated; Loamy Plains range site; tree planting suitability group 3.

Rough Broken Land

Rough broken land (Ro) consists of hilly and broken escarpments in uplands where severe geologic erosion and some accelerated erosion have cut deeply through interbedded fine-grained sandstones and sandy shales (fig. 10). The topography ranges from nearly vert[illegible] precipices to somewhat gentle slopes between and ab[illegible]

Figure 10.—Typical area of Rough broken land in background. Gullied land that is healing is in foreground.

the outcrops. A few smaller areas of soil, less than 20 acres in size, are included.

None of this land type is cultivated. It is unsuitable for cultivation because of the limitations resulting from steep slopes and shallow unstable soils. This land type is used for limited grazing.

Native grasses consist mainly of blue grama, western wheatgrass, little and big bluestems, side-oats grama, and Indian ricegrass. Capability unit VIIs-1, nonirrigated; Sandstone Breaks range site; tree planting suitability group 4.

Samsil Series

The Samsil series consists of well-drained, gently sloping to strongly sloping soils on uplands. These soils formed on clayey materials underlain by shale at a depth of 6 to 20 inches.

In a representative profile, the surface layer is pale-olive clay and silty clay about 7 inches thick. It is calcareous. Below a depth of 7 inches is olive silty clay and weathered shale. It is calcareous and contains large amounts of gypsum. Calcareous shale bedrock is at a depth of about 14 inches.

Samsil soils absorb water slowly, and the available water capacity is very low. Permeability is slow, and only the upper 7 inches of the soil is suitable for roots.

Representative profile of Samsil clay, 3 to 20 percent slopes, in an area of grass, 1,050 feet south and 860 feet of the northwest corner of section 19, T. 3 S., R. 5(W.:

A11—0 to 4 inches, pale-olive (2.5Y 6/3) clay, olive (5Y 4/3) when moist; weak, medium, granular structure; soft, friable; calcareous; strongly alkaline; clear, smooth boundary.

A12—4 to 7 inches, pale-olive (5Y 6/3) silty clay, olive (5Y 4/3) when moist; weak, medium, subangular blocky structure; hard, friable; calcareous and contains gypsum crystals; strongly alkaline; clear, smooth boundary.

ACcs—7 to 14 inches, silty clay and weathered shale, olive (5Y 4/3) when moist; massive; calcareous; large amount of calcium sulfate crystals; moderately alkaline; clear, wavy boundary.

R—14 inches, varicolored (olive greens and light grays), unweathered shale; calcareous; moderately alkaline.

The A horizon ranges from 1 to 7 inches in thickness, from pale olive to dark grayish brown in color, and from silty clay loam to clay in texture. Depth to bedrock ranges from 6 to 20 inches.

Samsil clay, 3 to 20 percent slopes (ScE).—This soil has the profile described as representative for the series. It is in scattered areas throughout the county. The areas are irregular in shape and range from 20 acres to about 200 acres in size.

Included in mapping are small areas of moderately sloping to strongly sloping Shingle-Renohill loams, which make up less than 10 percent of the unit. Surface runoff is rapid, and the hazard of water erosion is severe. This soil is used for limited grazing. Capability unit VIIe-6, nonirrigated; Shale Breaks range site; tree planting suitability group 4.

Samsil-Shingle complex, 3 to 35 percent slopes (ShF).—The gently sloping to steep soils in this complex are on uplands both east and west of the South Platte River.

These soils are thin over shale or interbedded shale and sandstone.

Samsil clay and Shingle loam are of about equal extent in the complex, but as much as 25 percent of it is made up of inclusions. Because the topography is so complex, the percentage of the individual inclusions varies widely and is not uniform from one part of the county to another.

Included in mapping, in areas west of the South Platte River, are remnants of Gravelly land, Shale outcrop, Gullied land, Renohill loam, and Ulm loam and narrow strips of Loamy alluvial land. These inclusions occupy the higher slopes and benches, except Loamy alluvial land.

Included in mapping, in areas east of the South Platte River, are areas of Renohill soils, Loamy alluvial land, and Shale outcrop. In the eastern part of the county, small areas of Adena and Colby soils are included.

Areas of this complex west of the South Platte River are divided about equally between grazing land and homesite developments. Areas east of the river are dominantly grazing land, and only a minor area is farmed. This complex is better suited to grazing than to other uses. Vegetation is western wheatgrass, buffalograss, blue grama, sacaton, winterfat, snakeweed, and cacti.

Limitations for homesite development areas include moderately steep slopes, poor drainage facilities, high shrink-swell clay, and corrosion. Moderately steep slopes, cracking of walls and foundations, and deterioration of untreated metal pipes, are some of the limitations for building construction. Care must be taken in these areas to overcome or correct these limitations. Capability unit VIIe-6, nonirrigated; tree planting suitability group 4. Samsil soils, Shale Breaks range site. Shingle soils, Loamy Slopes range site.

Sandy Alluvial Land

Sandy alluvial land (Sm) consists of an unstable accumulation of gravelly and sandy alluvium. It is in and adjacent to beds of intermittent streams throughout the eastern three-fourths of Adams County. During periods of heavy rain, the streambeds are subject to flooding, and channels are relocated and sediment is shifted and redeposited at slightly different locations. During dry spells, this land type is extremely droughty.

Sandy alluvial land consists of material that was transported by water from the sand and gravel beds in or adjacent to the area. It is stratified because of periodic flooding. Thin lenses or small pockets of silt, clay, and sand are also mixed with the gravel.

This land type differs from Wet alluvial land primarily in that it is coarser textured throughout and is not affected by a water table.

Sandy alluvial land is either barren or has only a sparse cover of weeds. It is used for grazing along with the better rangeland adjacent to it. Capability unit VIIw-1, nonirrigated; not placed in a range site; tree planting suitability group 4.

Satanta Series

The Satanta series consists of well-drained, nearly level soils on terraces. These soils formed in loamy alluvial material.

In a representative profile, the surface layer is brown loam about 9 inches thick. It is noncalcareous. The upper part of the subsoil is brown clay loam about 11 inches thick. It is noncalcareous. The lower part of the subsoil is pale-brown loam about 10 inches thick. It is highly calcareous, and some lime is visible as splotches. Between depths of 30 and 48 inches, the underlying material is pale-brown loam. It is highly calcareous, and some lime is visible as splotches. Below a depth of 48 inches, the underlying material is light yellowish-brown, stratified sandy loam and loamy sand and is highly calcareous.

Satanta soils absorb water at a moderate rate, and the available water capacity is high. Permeability is moderate, and the entire soil is suitable for roots.

Representative profile of Satanta loam, 0 to 1 percent slopes, in a cultivated field, 0.2 mile north and 55 feet east of the southwest corner of section 24, T. 2 S., R. 65 W.:

Ap1—0 to 5 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak, medium and fine, granular structure; soft, friable; noncalcareous; mildly alkaline; clear, smooth boundary.

Ap2—5 to 9 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; coarse blocky structure parting to moderate, medium, granular structure; slightly hard, friable; noncalcareous; mildly alkaline; abrupt, smooth boundary.

B2t—9 to 20 inches, brown (10YR 5/3) clay loam, dark brown (10YR 3/3) when moist; weak to moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; hard, friable; moderate clay films on horizontal and vertical faces of soil aggregates; noncalcareous; mildly alkaline; clear, smooth boundary.

B3ca—20 to 30 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; weak, coarse, prism structure parting to weak, medium, subangular blocky structure; hard, friable; thin patchy clay films; calcareous and contains visible lime occurring mostly as splotches; moderately alkaline; clear, wavy boundary.

C1ca—30 to 48 inches, pale-brown (10YR 6/3) loam, brown (10YR 5/3) when moist; massive; hard, very friable; calcareous and contains visible lime occurring as splotches; moderately alkaline; gradual, smooth boundary.

C2ca—48 to 60 inches, light yellowish-brown (2.5Y 6/4), stratified sandy loam and loamy sand, light olive brown (2.5Y 5/4) when moist; massive; slightly hard, very friable; calcareous and contains much lime visible as splotches; moderately alkaline.

The A horizon ranges from 4 to 9 inches in thickness, from dark grayish brown to brown in color, and from fine sandy loam to light clay loam in texture. The B horizon ranges from about 10 to 21 inches in thickness.

Satanta loam, 0 to 1 percent slopes (SnA).—This soil has the profile described as representative for the series. It is on river terraces, in areas that are oval in shape and range from 10 acres to 80 acres in size. Runoff is slow, and the hazards of water erosion and soil blowing are slight. Included in mapping are some small areas of Nunn loam and Dacono loam. All the acreage of this Satanta soil is cultivated and irrigated. Capability unit I-1, irrigated; not placed in a range site; tree planting suitability group 1.

Satanta loam, 1 to 3 percent slopes (SnB).—This soil is on stream terraces. The areas tend to be long and narrow and are generally parallel to present streams and older stream channels. They range from 10 to [illegible] acres in size. This soil has a profile similar to [illegible]

described as representative for the series, but the soil ·ers are slightly thinner. Surface runoff is medium, ...d the hazard of water erosion is moderate.

Nearly all areas of this soil are cultivated, and many of these are irrigated. In dryfarmed areas, winter wheat, barley, and sorghums are grown. This soil supports native grass, which includes blue grama and western wheatgrass. Capability unit IIe–1, irrigated, and IIIc–1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Shingle Series

The Shingle series consists of well-drained, gently sloping to steep soils on uplands. These soils formed in loamy material underlain by shale at a depth of 10 to 20 inches.

In a representative profile, the surface layer is light brownish-gray loam about 7 inches thick. It is highly calcareous. The underlying material is light yellowish-brown loam that is highly calcareous. Calcareous sandy shale bedrock is at a depth of about 12 inches.

Shingle soils absorb water at a moderate rate, and the available water capacity is very low. Permeability is moderate, and the entire soil is suitable for roots.

Representative profile of a Shingle loam having a slope of about 8 percent, in an area of grass, 1,400 feet west and 1,400 feet north of the southeast corner of section 33, T. 3 S., R. 58 W.:

A1—0 to 3 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; weak, fine, platy structure parting to weak, fine, granular structure; soft, friable; calcareous; moderately alkaline; clear, smooth boundary.

AC—3 to 7 inches, light brownish-gray (2.5Y 6/2) loam, grayish brown (2.5Y 5/2) when moist; weak, medium, subangular blocky structure; hard, friable; calcareous; moderately alkaline; gradual, smooth boundary.

C—7 to 12 inches, light yellowish-brown (2.5Y 6/3) loam, grayish brown to light olive brown (2.5Y 5/3) when moist; weak, coarse, subangular blocky structure parting to weak, medium, subangular blocky structure; hard, firm; calcareous; moderately alkaline; gradual, smooth boundary.

R—12 inches, stratified, varicolored, fine sandy shale and shaly sandstone; calcareous.

The A horizon ranges from 3 to 8 inches in thickness, from light brownish gray to pale brown in color, and, in places, from loam to heavy fine sandy loam in texture. The C horizon ranges from 5 to 18 inches in thickness, from loam to light silty clay loam in texture, and from very pale brown to light yellowish brown in color. Depth to bedrock ranges from 10 to 20 inches.

Shingle-Renohill loams, 5 to 25 percent slopes (SrE).—The moderately sloping to strongly sloping soils of this complex are on uplands. The soils are mainly Shingle loam and Renohill loam, and both are underlain by sandstone or by interbedded sandstone and sandy shale. They are intermingled with outcrops of fine-grained sandstone, some remnants of loess, a few shaly outcrops, and a small amount of Loamy alluvial land.

Shingle loam makes up about 40 percent of the complex and is nearer to the sandstone outcrops than Renohill loam, which makes up about 35 percent of the complex.

ᴵncluded in mapping are outcrops of sandstone or of ..ndstone and shale, which make up 10 percent of the complex; areas of Loamy alluvial lands, which make up 5 percent; slickspots, which make up 5 percent; and areas of Colby soils, which make up the remaining 5 percent. Some of the sandstone outcrops have a thin layer of gravel. Some of the sandstone knobs are large sandy concretions that are weathering into soil material.

Runoff is medium to rapid, and the hazard of erosion is moderate to severe. Gullies form in the swales, and sheet erosion occurs in exposed areas that have been cultivated or overgrazed. Steep, broken slopes cause limitations. Most areas of this complex have a cover of native grass. A few areas were cultivated at one time but have since been abandoned. Capability unit VIe–2, nonirrigated; Loamy Slopes range site; tree planting suitability group 4.

Stoneham Series

The Stoneham series consists of well-drained, nearly level to moderately sloping soils on uplands. These soils formed in loamy, old alluvial material.

In a representative profile (fig. 11), the surface layer is light grayish-brown loam about 5 inches thick. It is noncalcareous. The subsoil is brown sandy clay loam about 8 inches thick. It is noncalcareous. The underlying material is light-gray sandy loam and gravelly loam that is highly calcareous. At a depth of 30 inches, it is pale-brown gravelly sandy loam that is highly calcareous. It extends to a depth of about 60 inches.

Stoneham soils absorb water at a moderate rate, and the available water capacity is moderate. Permeability is moderate, and the entire soil is suitable for roots.

Representative profile of Stoneham loam, 3 to 9 percent slopes, in an area of grass, 170 feet south and 20 feet east of the northwest corner of section 21, T. 3 S., R. 59 W.:

A1—0 to 5 inches, light grayish-brown (10YR 6/2) loam, dark grayish brown (10YR 4/2) when moist; weak, medium, granular structure; soft, friable; many fibrous roots; noncalcareous; neutral; clear, smooth boundary.

B2t—5 to 13 inches, brown (10YR 5/3) sandy clay loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to weak to moderate subangular blocky structure; thin clay films on ped faces; hard, friable; noncalcareous; mildly alkaline; gradual, smooth boundary.

C1ca—13 to 20 inches, light-gray (10YR 7/2) sandy loam, pale brown (10YR 6/3) when moist; weak, medium, subangular blocky structure; hard, friable; calcareous and contains lime in splotches and disseminated; moderately alkaline; clear, smooth boundary.

IIC2ca—20 to 30 inches, light-gray (10YR 7/2) gravelly loam, pale brown (10YR 6/3) when moist; massive; hard, friable; 15 percent gravel; calcareous and contains common, medium and coarse, lime mottles (10YR 8/2) and disseminated lime; moderately alkaline; clear, smooth boundary.

IIC3—30 to 60 inches, pale-brown (10YR 6/3) gravelly sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; 18 percent gravel; calcareous and contains disseminated lime; moderately alkaline; clear, wavy boundary.

The A horizon ranges from 3 to 7 inches in thickness, from grayish brown to pale brown in color, and from heavy fine sandy loam to loam in texture. The B horizon ranges from 5 to 16 inches in thickness, from brown to light brown in color, and from light clay loam to coarse sandy loam in texture. Depth to calcareous material ranges from 3 to 15 inches.

Figure 11.—Profile of a Stoneham loam.

Stoneham loam, 0 to 3 percent slopes (StB).—This soil is in scattered areas along major stream channels in the county. It is on uplands back from the stream channels. The areas are irregular in shape and range from 30 to 50 acres in size. This soil has a profile similar to the one described as representative for the series, but it has a thicker surface layer and subsoil. Runoff is medium to slow. Water erosion and soil blowing are moderate hazards. Included in mapping are a few small areas of Platner loam that commonly are in small depressional areas.

Most areas of this soil are cultivated, but a few areas remain in native grass. Capability unit IVe-3, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Stoneham loam, 3 to 9 percent slopes (StD).—This soil has the profile described as representative for the series. It is on uplands near major stream channels in scattered areas throughout the county. The areas are uniform in shape and range from 50 to 80 acres in size. Runoff is generally medium but is rapid if the soil is unprotected. The hazards of water erosion and soil blowing are severe in cultivated areas. Gullies form in drainageways in some places. Included in mapping are small areas of sand and gravel deposits and a few small areas of Ascalon soils.

Most areas of this soil are cultivated, but some areas have a cover of native grass. Capability unit VIe-1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Tassel Series

The Tassel series consists of well-drained to somewhat excessively drained, gently sloping to strongly sloping soils on uplands. These soils formed in loamy material underlain by sandstone at a depth of 10 to 20 inches.

In a representative profile, the surface layer is brown and pale-brown fine sandy loam about 5 inches thick. It is calcareous The underlying material is very pale brown and light yellowish-brown fine sandy loam. It is highly calcareous. Sandstone bedrock is at a depth of 18 inches. Sandstone fragments are generally throughout.

Tassel soils absorb water rapidly, and the available water capacity is low. Permeability is moderately rapid, and the entire soil is suitable for roots.

Representative profile of a Tassel fine sandy loam having a slope of 6 percent, in an area of grass, 2,600 feet east and 1,300 feet south of the northwest corner of section 4, T. 3 S., R. 58 W.:

A11—0 to 2 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; very weak, thin, platy structure; soft, friable; calcareous; mildly alkaline; clear, smooth boundary.

A12—2 to 5 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, fine granular structure; slightly hard, friable; calcareous; mildly alkaline; clear, smooth boundary.

AC—5 to 11 inches, very pale brown (10YR 7/3) fine sandy loam, pale brown (10YR 6/3) when moist; weak, medium, subangular blocky structure; hard, friable; calcareous; moderately alkaline; clear, wavy boundary.

C—11 to 18 inches, light yellowish-brown (2.5Y 6/3) fine sandy loam, olive brown (2.5Y 4/3) when moist; massive; soft, friable; calcareous; moderately alkaline; clear, wavy boundary.

R—18 inches, partially weathered, soft sandstone beds; variable in color, texture, and hardness.

The A horizon ranges from 2 to 7 inches in thickness, from pale brown to grayish brown in color, and from fine sandy loam to loamy fine sand in texture. The C horizon ranges from 7 to 18 inches in thickness over sandstone and from very pale brown to light yellowish brown and pale yellow in color. Depth to bedrock ranges from 10 to 20 inches.

Terrace Escarpments

Terrace escarpments (Tc) occur as breaks or steep side slopes adjacent to the channels of present or former streams. They also occur as the steep faces of terraces that border bottom lands and flood plains.

This land type consists of alluvium of variable materials and is very shallow over gravel and sand. These materials have a loamy sand or sandy loam surface layer. In many areas this layer is 5 to 20 percent gravel. Shale and sandstone outcrops are in some areas. Included in mapping are very small areas of a Vona loamy sand, a Vona sandy loam, and a Dacono loam, all good soils for farming.

The surface layer varies in reaction from place to place and in places is calcareous. Slopes differ widely within short distances and range from 1 to 80 percent. Some areas are used for grazing, but the soils are too steep, too shallow, or too unstable for cultivation or good grass management.

Much of this land type is rapidly being mined for sand and gravel, and thereafter is not usable for farming. Such areas are used as a dumping ground or are back filled with better soil material in places. Many areas of this land type are well suited to housing or industrial developments or highway location. Prior to use for these purposes, however, the stability of the soils should be determined because of slope or lack of binder soil particles. The soils normally have good bearing capacity for foundations, low shrink-swell properties, good natural drainage, and a low hazard of hydrolysis for buried metal pipe. Open ditches for transporting water are not suited because of rapid seepage.

In some areas lawns and gardens would have to be built up, using better soil materials from other areas. In some areas, old gravel pits have been used as dump areas, then packed and filled with outside soil materials, and then developed for homesites. Capability unit VIIe-3, nonirrigated; Gravel Breaks range site; tree planting suitability group 4.

Terry Series

The Terry series consists of well-drained to somewhat excessively drained, nearly level to strongly sloping soils on uplands. These soils formed in loamy material over sandstone. Sandstone is at a depth of 20 to 40 inches.

In a representative profile, the surface layer is brown, calcareous fine sandy loam about 5 inches thick. The upper part of the subsoil is pale-brown, calcareous fine sandy loam about 6 inches thick. The lower part of the subsoil is pale-brown, highly calcareous sandy loam about 7 inches thick. Some lime is visible as faint splotches. The underlying material is very pale brown fine sandy loam and light yellowish-brown loamy fine sand. It is highly calcareous, and lime is visible as streaks and mottles. This material generally contains sandstone fragments. Sandstone bedrock is at a depth of about 39 inches.

Terry soils absorb water rapidly, and the available water capacity is low. Permeability is moderately rapid, and the entire soil is suitable for plant roots.

Representative profile of Terry fine sandy loam, 3 to 9 percent slopes, in an area of grass, 2,200 feet north and 158 feet east of the southwest corner of section 34, T. 2 S., R. 59 W.:

A1—0 to 5 inches, brown (10YR 5/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, blocky structure parting to single grain; slightly hard, very friable; mildly alkaline; calcareous; clear, smooth boundary.

B2t—5 to 11 inches, pale-brown (10YR 6/3) fine sandy loam, dark brown (10YR 4/3) when moist; weak to moderate, medium, prismatic structure parting to weak to moderate, medium, subangular blocky structure; slightly hard, friable; thin patchy clay films on faces of peds; calcareous; mildly alkaline; clear, smooth boundary.

B3ca—11 to 18 inches, pale-brown (10YR 6/3) sandy loam, brown (10YR 5/3) when moist; very weak, medium, subangular blocky structure; hard, friable; very thin patchy clay films on peds; calcareous and contains lime in faint splotches; moderately alkaline; gradual, smooth boundary.

C1ca—18 to 23 inches, very pale brown (10YR 7/3) fine sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, friable; calcareous and contains lime in streaks; moderately alkaline; gradual, smooth boundary.

C2ca—23 to 39 inches, light yellowish-brown (2.5Y 6/4) loamy fine sand, light olive brown (2.5Y 5/4) when moist; massive; hard, friable; calcareous and contains lime in common, medium, prominent mottles; moderately alkaline; clear, wavy boundary.

R—39 inches, soft but inhibiting fine-grained sandstone, light gray (10YR 7/1); noncalcareous, except mildly calcareous in spots; moderately alkaline.

The A horizon ranges from 2 to 6 inches in thickness, from grayish brown to pale brown in color, and from loamy fine sand to fine sandy loam in texture. The B horizon ranges from 6 to 24 inches in thickness. Depth to calcareous material ranges from 0 to 20 inches. Depth to bedrock ranges from 20 to 40 inches.

Terry fine sandy loam, 0 to 3 percent slopes (TeB).—This nearly level to very gently sloping soil is in irregularly shaped areas that range from 20 to 60 acres in size. This soil has a profile that is similar to the profile described as representative for the series, but it has a thicker surface layer and subsoil. Surface runoff is slow, and the hazard of water erosion is slight. Soil blowing is a severe hazard in unprotected areas. Included in mapping are small areas of soils that have more clay in the subsoil than this soil.

Much of this soil is cultivated. Small areas are in native grass. Capability unit IVe-5, nonirrigated; Sandy Plains range site; tree planting suitability group 3.

Terry fine sandy loam, 3 to 9 percent slopes (TeD).—This soil has the profile described as representative for the series. It is on uplands, in areas that are irregular in shape and range from 20 to 40 acres in size. Surface runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is severe.

Included in mapping, in the steeper and more broken areas, are a few small areas of Tassel and Ulm soils and a few sandstone outcrops.

Most of this soil is in native grass. A few isolated areas are cultivated. Many old fields have been reseeded to grass and are now used for grazing. Capability unit VIe-4, nonirrigated; Sandy Plains range site; tree planting suitability group 3.

Terry-Tassel-Ulm complex, 3 to 20 percent slopes (TrE).—This complex is in rough upland areas. It is characterized by gently sloping to strongly sloping soils. In many places the landscape is dotted with outcrops of fine-grained sandstone. There are swales and coves of deeper soils, as well as long ridges and slopes of shallow and moderately deep soils over interbedded, soft, fine-grained sandstone and sandy shale.

Terry soils make up about 50 percent of this complex; Tassel soils, 30 percent, and Ulm soils, nearly 20 percent. Included in mapping are a few small remnants of loess on ridges and slopes, some sandstone outcrops, and some small areas of Loamy alluvial land.

Terry fine sandy loam occupies the long, narrow ridges and has many of the more smooth but commonly strong slopes. Tassel fine sandy loam is close to and

associated with the sandstone outcrops. Ulm and Ulm-like soils having a loam surface layer are in the swales and coves.

Soils of this complex are not suitable for cultivation. Many old fields have been abandoned and allowed to return to native cover or have been reseeded to grass. Only a few areas are cultivated at this time. Runoff is slow to rapid, and the hazard of erosion is slight to severe.

The native vegetation is mainly blue grama, side-oats grama, western wheatgrass, little and big bluestems, sand dropseed, sand bluestem, needle-and-thread, buckwheat, and yucca. Capability unit VIe-4, nonirrigated; tree planting suitability group 3. Terry soils, Sandy Plains range site. Tassel soils, Sandy Plains range site. Ulm soils, Loamy Plains range site.

Terry-Vona-Tassel complex, 3 to 20 percent slopes (TsE).—This complex consists of sandy soils on uplands. The areas are dissected by many major and side drains.

Terry fine sandy loam makes up about 45 percent of the complex; Vona sandy loam, about 30 percent; and Tassel soils and the nearby outcrops together, about 20 percent. Included with these soils in mapping are areas of Valent soils, which make up most of the remaining 5 percent. Also included are some small areas of Sandy alluvial land.

Terry fine sandy loam occupies the higher ridges and the smoother side slopes. Vona sandy loam is in the more gently sloping areas and depressions. Tassel fine sandy loam occupies rough areas near sandstone outcrops.

Runoff is slow to rapid on these soils, and the hazard of erosion is slight to severe. The rough terrain and risk of soil blowing in areas having no cover are the main concerns of management. Severe erosion and small blowouts occur in spotted patterns in some old fields or heavily grazed areas. The soils are too sandy for cultivation, but under good grazing management, they produce prairie sandreed, big bluestem, sand bluestem, and other grasses. Capability unit VIe-4, nonirrigated; Sandy Plains range site; tree planting suitability group 3.

Truckton Series

The Truckton series consists of well-drained to somewhat excessively drained, nearly level to moderately sloping soils on uplands. These soils formed in wind-worked sandy material.

In a representative profile, the surface layer is grayish-brown and dark grayish-brown loamy sand about 9 inches thick. It is noncalcareous. The upper part of the subsoil is dark-brown and brown sandy loam about 12 inches thick. It is noncalcareous. The lower part of the subsoil is yellowish-brown loamy sand about 11 inches thick. It is noncalcareous. The underlying material is yellowish-brown coarse sand that extends to a depth of 60 inches or more.

Truckton soils absorb water rapidly, and the available water capacity is low. Permeability is rapid, and the entire soil is suitable for roots.

Representative profile of Truckton loamy sand, 3 to 9 percent slopes, in an area of grass, 0.25 mile south and 54 feet west of the northeast corner of section 14, T. 3 S., R. 66 W.:

A11—0 to 3 inches, grayish-brown (10YR 5/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; very weak, fine, granular structure; loose, very friable; neutral; clear, smooth boundary.

A12—3 to 9 inches, dark grayish-brown (10YR 4/2) loamy sand, very dark grayish brown (10YR 3/2) when moist; very weak, coarse, subangular blocky structure parting to very weak, fine, granular structure; soft, very friable; neutral; clear, smooth boundary.

B21t—9 to 14 inches, dark-brown (10YR 4/3) sandy loam, dark brown (10YR 3/3) when moist; weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; soft, friable; thin patchy clay films on vertical faces of the peds; neutral; clear, smooth boundary.

B22t—14 to 21 inches, brown (10YR 5/3) sandy loam, dark brown (10YR 4/3) when moist; moderate, medium, prismatic structure parting to moderate, medium, subangular blocky structure; very hard, firm; clay films on all ped faces; neutral; clear, smooth boundary.

B3—21 to 32 inches, yellowish-brown (10YR 5/4) loamy sand, dark yellowish brown (10YR 4/4) when moist; weak, coarse, subangular blocky structure; very hard, friable; thin patchy clay films; neutral; gradual, wavy boundary.

C—32 to 60 inches, yellowish-brown (10YR 5/4) coarse sand, dark yellowish brown (10YR 4/4) when moist; massive; very hard; friable; neutral.

The A horizon ranges from 6 to 10 inches in thickness, from grayish brown to dark grayish brown in color, and from sandy loam to loamy sand in texture. The B horizon ranges from 6 to 23 inches in thickness.

Truckton loamy sand, 0 to 3 percent slopes (TtB).—This soil is mainly along major stream channels. It has a profile similar to the one described as representative for the series, but the surface layer and subsoil are thicker. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is seve in areas without adequate plant cover. Included in mapping are a few small areas of Vona loamy sand.

Most areas of this soil are cultivated (fig. 12). Many small, scattered areas are under native grass. Capability unit IIIe-5, irrigated, and IVe-9, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Truckton loamy sand, 3 to 9 percent slopes (TtD).—This soil has the profile described as representative for the series. It is mostly along major stream channels. Slopes are irregular but are dominantly 4 to 9 percent. Surface runoff is medium, and the hazards of soil blowing and water erosion are severe.

Included in mapping are small areas of Blakeland loamy sand. The Blakeland soil commonly is on the top of slopes, and this Truckton soil is on the gentle side slopes.

Much of this soil is cultivated. Some of the more strongly sloping areas have a cover of native grass. The soil is generally unsuitable for cultivation and is better suited to permanent grass. Capability unit VIe-4, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Truckton sandy loam, 1 to 3 percent slopes (TuB).—This soil is in areas that are irregular in shape and range from 30 to 300 acres in size. It has a profile similar to the one described as representative for the series, but it has a sandy loam surface layer and a thicker surface layer and subsoil. Included in mapping are some areas where slopes are less than 1 perce Surface runoff is slow to medium, and the hazard o

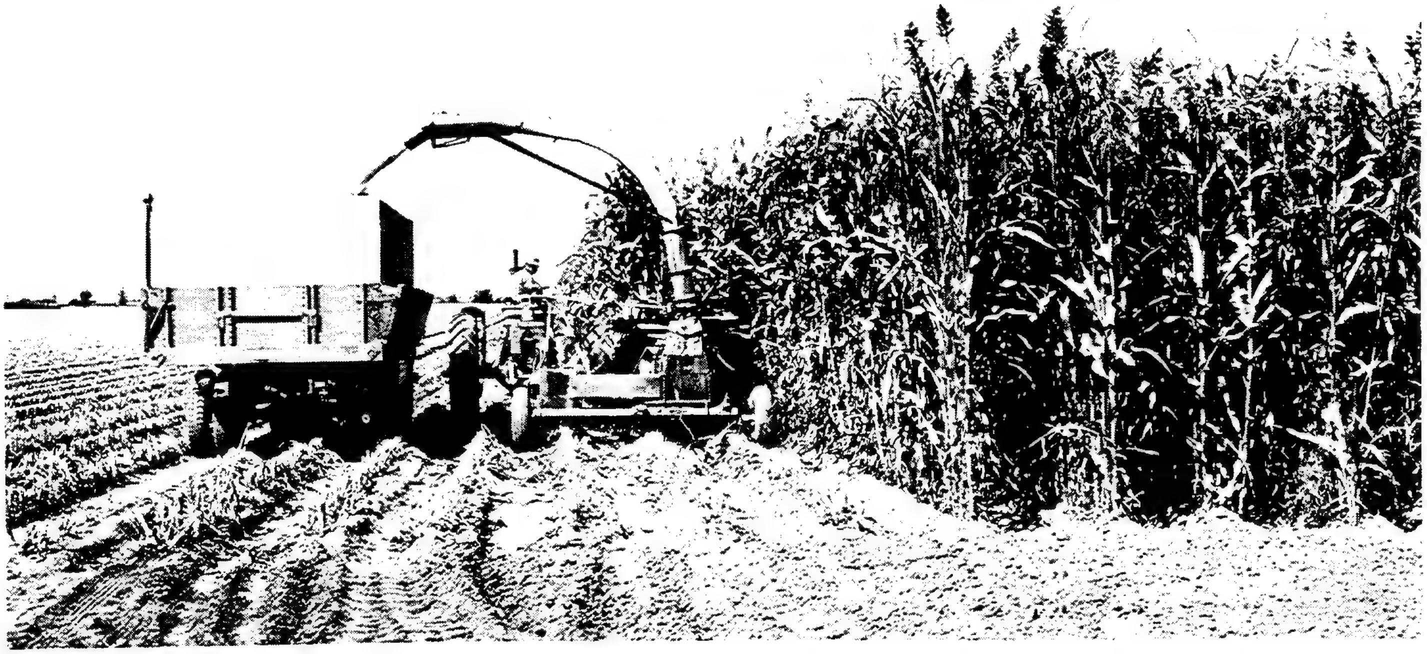

Figure 12.—Corn growing on irrigated Truckton soils.

water erosion is slight. The hazard of soil blowing is severe.

About half of this soil is cultivated, and the cultivated acreage is about evenly divided between irrigated farming and dryfarming. The rest has a cover of native grass. Capability unit IIIe–4, irrigated, and IIIe–7, nonirrigated: Sandy Plains range site; tree planting suitability group 2.

Truckton sandy loam, 3 to 5 percent slopes (TuC).—This soil is on uplands, in areas that are irregular in shape and range from 20 to 80 acres in size. It has a profile similar to the one described as representative for the series, but it has a sandy loam surface layer. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is severe. This soil is more difficult to work, more susceptible to erosion, and more difficult to keep from eroding than are similar soils having less slope. Included in mapping are areas of Vona sandy loam and other soils that have more lime in the profile.

All of this soil is cultivated. It can be irrigated, except for some areas in the southwestern part of the county where industry and housing are expanding. None of this soil is dryfarmed. Capability unit IIIe–3, irrigated; not placed in a range site; tree planting suitability group 2.

Truckton sandy loam, 3 to 9 percent slopes (TuD).—This soil has a profile that is similar to the one described as representative for the series, but it has a sandy loam surface layer. Areas of this soil are irregular in shape and range from 30 to 300 acres in size. Runoff is medium, and the hazard of water erosion is moderate. The hazard of soil blowing is severe.

Included in mapping, in some of the rougher places, are small areas of Truckton loamy sand and Blakeland loamy sand.

Some areas of this soil are cultivated, and some old fields have been reseeded to grass. Most areas of the soil have a cover of native grass. None of it is irrigated. Capability unit VIe–4, nonirrigated: Sandy Plains range site; tree planting suitability group 2.

Ulm Series

The Ulm series consists of well-drained, nearly level to moderately sloping soils on uplands. These soils formed in loamy material derived from shale and sandstone, which are at depths of more than 40 inches.

In a representative profile, the surface layer is light brownish-gray heavy loam about 7 inches thick. It is noncalcareous. The upper part of the subsoil is brown silty clay and pale-brown clay about 15 inches thick. It is noncalcareous to slightly calcareous. The lower part of the subsoil is pale-brown, highly calcareous clay about 8 inches thick. The underlying material is light yellowish-brown clay loam. It contains a few small pieces of sandstone, is highly calcareous, and contains some lime that is visible as streaks. Bedrock is at a depth of about 48 inches.

Ulm soils absorb water at a slow to moderate rate, and the available water capacity is high. Permeability is slow, and the entire soil is suitable for plant roots.

Representative profile of Ulm loam, 3 to 5 percent slopes, in a cultivated field, 0.2 mile east and 275 feet north of the southwest corner of section 18, T. 1 S., R. 68 W.:

Ap—0 to 7 inches, light brownish-gray (10YR 6/2) heavy loam, dark grayish brown (10YR 4/2) when moist; weak, fine, granular structure; slightly hard, friable; noncalcareous; mildly aklaline; abrupt, smooth boundary.

B21t—7 to 13 inches, brown (10YR 4/2) silty clay, dark grayish brown (10YR 4/2) when moist; moderate,

medium, prismatic structure parting to strong, medium, angular blocky structure; thin continuous clay films; hard, firm; noncalcareous; mildly alkaline; clear, wavy boundary.

B22t—13 to 22 inches, pale-brown (10YR 6/3) clay, yellowish brown (10YR 5/4) when moist; moderate to strong, medium, angular and subangular blocky structure; thin continuous clay films; hard, firm; calcareous; moderately alkaline; gradual, wavy boundary.

B3ca—22 to 30 inches, pale-brown (10YR 6/3) clay; yellowish brown (10YR 5/4) when moist; moderate, coarse, prismatic structure parting to moderate, medium, subangular blocky structure; hard, firm; calcareous and contains lime disseminated and in streaks; moderately alkaline; gradual, wavy boundary.

Cca—30 to 48 inches, light yellowish-brown (10YR 6/4) clay loam, yellowish brown (10YR 5/4) when moist; massive; very hard, friable; few fragments of soft partially disintegrated sandstone; calcareous and contains lime disseminated and in streaks; moderately alkaline; gradual, wavy boundary.

R—48 inches, shale beds; some interbedding of soft shaly sandstone; calcareous.

The A horizon ranges from 4 to 8 inches in thickness, from grayish brown to light gray in color, and from heavy fine sandy loam to light clay loam in texture. The B horizon ranges from clay loam to clay in texture and from 8 to 26 inches in thickness. Depth to lime ranges from 12 to 30 inches. Depth to bedrock ranges from 40 inches to more than 60 inches.

Ulm loam, 1 to 3 percent slopes (UlB).—This soil is in areas that are irregular in shape but tend to be longer north and south than east and west. They range from 60 to 250 acres in size. Runoff is slow, and the hazard of water erosion is moderate to slight. Natural fertility is fair to good. This soil has a profile similar to the one described as representative for the series, but it has a thicker surface layer and subsoil. Included in mapping are some areas where the lower part of the subsoil is plastic and causes difficulty in digging. Such areas also reduce permeability.

Most areas of this soil are cultivated. None of it is irrigated. A few areas remain in grass. Capability unit IVe-3, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Ulm loam, 3 to 5 percent slopes (UlC).—This soil has the profile described as representative for the series. It is on ridges or has long slopes adjacent to drainageways. The areas are irregular in shape and range from 50 to 200 acres in size. Surface runoff is medium, and the hazard of water erosion is severe. Gullies form rapidly. Soil blowing is also a hazard to unprotected fields. Areas of this soil in the extreme western part of the county tend to have more clay in the subsoil. Such layers somewhat restrict permeability and drainage and tend to build up a water table and soluble salts. Included in mapping are small areas of Renohill loam in rougher areas.

Most of this soil is or has been cultivated. Most of the cultivated acreage is dryfarmed, but some is irrigated. Some areas remain in grass. Capability unit IIIe-1, irrigated, and IVe-4, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Ulm loam, 5 to 9 percent slopes (UlD).—This soil has a profile similar to the one described as representative for the series, but it has a thinner surface layer and subsoil. The areas are irregular in shape and range from 25 to 150 acres in size. Runoff is generally medium, but it increases if the soil does not have an adequate cover of plants. Also, the hazard of sheet and gully erosion is greater if vegetation is lacking. The hazard of soil blowing is moderate. Natural fertility is moderate to good.

Included in mapping are small areas of Renohill loam and Samsil clay loam on steeper areas.

Most areas of this soil are or have been cultivated. Many fields have been abandoned or reseeded to grass. Much of the cultivated acreage was dryfarmed. Some areas are irrigated, and some small areas remain in grass. Capability unit IVe-1, irrigated, and VIe-1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Valent Series

The Valent series consists of excessively drained, nearly level to moderately sloping soils that are mainly on uplands. A few areas are on bottom lands near stream channels. These soils formed in wind-worked sandy material.

In a representative profile, the surface layer is pale-brown loamy sand about 7 inches thick. The next layer is light brownish-gray loamy fine sand that extends to a depth of about 15 inches, where it grades to pale-brown loamy sand. The profile is noncalcareous.

Valent soils absorb water rapidly, and the available water capacity is low. Permeability is very rapid, and the entire soil is suitable for plant roots.

Representative profile of Valent loamy sand, 1 to 9 percent slopes, in an area of grass, 2,240 feet east and 0.4 mile north of the southwest corner of section 11, T. 1 S., R. 60 W.:

A1—0 to 7 inches, pale-brown (10YR 6/3) loamy sand, dark brown (10YR 4/3) when moist; weak, fine, subangular blocky structure parting to weak, very fine, granular structure; soft, friable; neutral; clear, smooth boundary.

AC—7 to 15 inches, light brownish-gray (10YR 6/2) loamy fine sand, dark grayish brown (10YR 4/2) when moist; very weak, medium, subangular blocky structure parting to single grain; soft, friable; neutral; clear, smooth boundary.

C—15 to 60 inches, pale-brown (10YR 6/3) loamy sand, brown (10YR 5/3) when moist; very weak, coarse, subangular blocky structure parting to single grain; slightly hard, friable; neutral.

The A horizon ranges from 4 to 9 inches in thickness, from grayish brown to pale brown in color, and from loamy sand to sand in texture. The AC horizon ranges from loamy sand to loamy fine sand and from 6 to 12 inches in thickness.

Valent loamy sand, 1 to 9 percent slopes (VaD).—This soil is normally on uplands but is close to stream bottoms in places. It is in long narrow bands that are nearly a mile long in places and less than one-fourth mile wide. These areas range from 30 to 150 acres in size. Surface runoff is slow, and the hazard of water erosion is slight. The hazard of soil blowing is severe.

Most areas of this soil have a cover of grass. Most areas that were formerly cultivated have been reseeded to grass. Capability unit VIe-5, nonirrigated; Deep Sand range site; tree planting suitability group 3.

Vona Series

The Vona series is made up of well-drained, nearly level to moderately sloping soils on uplands. These soils formed in wind-deposited sandy material.

In a representative profile, the surface layer is light brownish-gray loamy sand about 9 inches thick. It is noncalcareous. The subsoil is pale-brown coarse sandy loam about 13 inches thick. It is noncalcareous. The underlying material is light yellowish-brown sandy loam and very pale brown, highly calcareous loamy sand that contains lime visible as splotches.

Vona soils absorb water rapidly, and the available water capacity is moderate. Permeability is rapid, and the entire soil is suitable for plant roots.

Representative profile of Vona loamy sand, 3 to 9 percent slopes, in a cultivated field, 350 feet west and 150 feet north of the southeast corner of section 14, T. 2 S., R. 65 W.:

Ap—0 to 9 inches, light brownish-gray (10YR 6/2) loamy sand, dark grayish brown (10YR 4/2) when moist; very weak, coarse, blocky structure parting to weak, fine, granular structure; slightly hard, very friable; noncalcareous; neutral; abrupt, smooth boundary.

B2t—9 to 22 inches, pale-brown (10YR 6/3) coarse sandy loam, dark brown (10YR 4/3) when moist; weak, coarse, prismatic structure parting to weak, medium, subangular blocky structure; hard, friable; patchy clay films on faces of peds; noncalcareous; neutral; clear, smooth boundary.

C1ca—22 to 27 inches, light yellowish-brown (10YR 6/4) sandy loam, dark yellowish brown (10YR 4/4) when moist; massive; hard, friable; calcareous and contains a few splotches of lime in places; moderately alkaline; clear, wavy boundary.

C2ca—27 to 40 inches, very pale brown (10YR 7/3) coarse sandy loam, pale brown (10YR 6/3) when moist; massive; hard, friable; calcareous and contains lime disseminated and in splotches; moderately alkaline; clear, wavy boundary.

C3ca—40 to 60 inches, very pale brown (10YR 7/3) loamy sand, brown (10YR 5/3) when moist; massive; very friable; calcareous and contains from weak to strong visible lime; moderately alkaline.

The A horizon ranges from 5 to 10 inches in thickness, from grayish brown to very pale brown in color, and from sandy loam to loamy sand in texture. The B horizon ranges from 6 to 20 inches in thickness and from grayish brown to light yellowish brown in color. Depth to calcareous material ranges from 11 to 30 inches.

Vona loamy sand, 0 to 3 percent slopes (VnB).—This soil is on uplands, in areas that are irregular in shape and range from 30 to 200 acres in size. Surface runoff is moderate to slow, and the hazard of water erosion is slight. The hazard of soil blowing is moderate to severe. This soil has a profile similar to the one described as representative for the series, but the surface layer and subsoil are thicker.

Most areas of this soil are cultivated. Some small, scattered areas have a cover of native grass. Some areas are irrigated. Capability unit IIIe-5, irrigated, and IVe-8, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Vona loamy sand, 3 to 9 percent slopes (VnD).—This soil has the profile described as representative for the series. The areas are irregular in shape and range from 20 to 250 acres in size. Surface runoff is medium, and the hazard of soil blowing is severe. Included in mapping are small areas of Valent loamy sand.

Much of this soil is or has been cultivated. Many small areas remain in native grass. Many old fields have been seeded to grass and are now used for grazing. This soil is not suitable for cultivation because of the hazard of erosion. Capability unit VIe-4, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Vona sandy loam, 0 to 1 percent slopes (VoA).—This soil is on river terraces. The areas are irregular in shape and range from 200 to 250 acres in size. Runoff is slow, and the hazards of water erosion and soil blowing are only slight.

This soil has a profile similar to the one described as representative for the series, but it has a sandy loam surface layer and a thicker surface layer and subsoil. Included in mapping are small areas of Dacono loam near the terrace edges.

All of this soil is cultivated and irrigated. It is an important soil because truck farming is highly developed in this area (fig. 13). Capability unit IIs-2, irrigated; not placed in a range site; tree planting suitability group 2.

Vona sandy loam, 1 to 3 percent slopes (VoB).—This soil has a profile similar to that described as representative for the series, but it has a sandy loam surface layer. The areas are extremely irregular in shape and range from 30 to 200 acres in size. The hazards of water erosion and soil blowing are moderate. Included in mapping, on small ridges and mounds on uplands, are small areas of Vona loamy sand. Also included, in irrigated areas, are some small areas of Dacono loam near terrace edges.

Much of this soil is or has been cultivated. Some formerly irrigated areas have been or are being developed for industry and housing. In general, this soil is suitable for housing projects and has few limitations for construction. It is well suited to most irrigated and dry-farmed crops, but it is not so suitable for truck farming as the nearly level Vona sandy loam. It is an excellent soil for native grass. Capability unit IIIe-4, irrigated, and IVe-5, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Figure 13.—**Head lettuce growing on irrigated Vona soils.**

Vona sandy loam, 3 to 5 percent slopes (VoC).—This soil has a profile similar to the one described as representative for the series, but it has a sandy loam surface layer and a thinner subsoil. The hazards of water erosion and soil blowing are severe.

All of this soil is cultivated and irrigated or being developed for homesites or light industry. It is well suited to crops, including alfalfa and corn for ensilage, and to all adapted sandyland grasses. Planted pastures grow well if irrigation water is applied, especially if sprinkler irrigation is used and if a good sod is maintained.

A large acreage of this soil is in areas where industrialization and home building are encroaching on farmland. This soil has few limitations for buildings other than soil blowing. It is well suited to use for housing developments .Capability unit IIIe–3, irrigated; not placed in a range site; tree planting suitability group 2.

Vona-Ascalon loamy sands, 3 to 9 percent slopes (VsD).—This complex is on uplands. Vona loamy sand makes up at least 60 percent of this complex and Ascalon loamy sand makes up the remaining 40 percent. Included in mapping are a few small areas of Terry fine sandy loam.

The Ascalon soil has a profile similar to the one described as representative for the Ascalon series, but it has a thinner surface layer and subsoil.

Some areas of this complex are being farmed, mainly to winter wheat. Some barley is grown, and sorghums are planted in areas where the normal crops have been destroyed by drought or erosion. Severe erosion in the form of blowouts near the tops of hills and ridges is common in cultivated areas. Many old fields have been abandoned, and some have been reseeded to grass. Capability unit VIe–4, nonirrigated; Sandy Plains range site; tree planting suitability group 2.

Weld Series

The Weld series consists of well-drained, nearly level soils on uplands. These soils formed in wind-worked loamy materials.

In a representative profile, the surface layer is brown loam about 6 inches thick. It is noncalcareous. The upper part of the subsoil is dark-brown clay about 6 inches thick. It is noncalcareous. The lower part of the subsoil is pale-brown and very fine sandy loam about 20 inches thick. It is highly calcareous, and much of the lime is visible as splotches. The underlying material is highly calcareous, pale-brown silt loam and light yellowish-brown fine sandy loam.

Weld soils absorb water at a moderate rate, and the available water capacity is high. Permeability is slow, and the entire soil is suitable for plant roots.

Representative profile of Weld loam, 1 to 3 percent slopes, in an area of grass, 0.25 mile east and 75 feet north of the southwest corner of section 36, T. 3 S., R. 59 W.:

A1—0 to 6 inches, brown (10YR 5/3) loam, dark brown (10YR 3/3) when moist; weak to moderate, fine, granular structure; soft, friable; noncalcareous; mildly alkaline; abrupt, smooth boundary.

B2t—6 to 12 inches, dark-brown (10YR 4/3) clay, dark brown (10YR 3/3) when moist; strong, fine, prismatic structure parting to strong, medium and fine, angular and subangular blocky structure; hard, firm; continuous clay films; graying in cracks in upper part; noncalcareous; mildly alkaline; clear, smooth boundary.

B31ca—12 to 21 inches, pale-brown (10YR 6/3) loam, brow (10YR 5/3) when moist; weak to moderate, medium, prismatic structure parting to moderate, medium to coarse, subangular blocky structure; slightly hard, friable; thin patchy clay films; calcareous and contains lime disseminated and in splotches; moderately alkaline; clear, smooth boundary.

B32ca—21 to 32 inches, pale-brown (10YR 6/3) very fine sandy loam, brown (10YR 5/3) when moist; weak, coarse, prismatic structure parting to weak, coarse, subangular blocky structure; soft, very friable; thin patchy clay films on vertical faces; calcareous and contains lime disseminated and in splotches; strongly alkaline; clear, smooth boundary.

C1ca—32 to 58 inches, pale-brown (10YR 6/3) silt loam, brown (10YR 5/3) when moist; massive; soft, very friable; calcareous and contains lime disseminated and in finely divided particles; moderately alkaline; clear, wavy boundary.

C2ca—58 to 68 inches, light yellowish-brown (10YR 6/4) fine sandy loam, yellowish brown (10YR 5/4) when moist; massive; soft, very friable; calcareous and contains lime disseminated and in finely divided particles; strongly alkaline.

The A horizon ranges from 4 to 8 inches in thickness, from brown to dark grayish brown in color, and from loam to silt loam in texture. The B horizon ranges from 10 to 28 inches in thickness. Depth to lime ranges from 10 to 20 inches.

Weld loam, 1 to 3 percent slopes (WmB).—This soil has the profile described as representative for the series. It is on uplands. The areas are irregular in shape and range from 30 to 700 acres in size. Surface runoff is medium, and the hazard of water erosion is moderate to severe. The hazard of soil blowing is severe in dryfarmed areas if rainfall is below normal.

Included in mapping are some small areas wher. slopes are less than 1 percent. Also included are some small areas of Adena loam that are in most sloping areas.

Almost all of this Weld soil is cultivated. A few areas are irrigated. Scattered areas throughout the county are in native grass. Capability unit IIe–1, irrigated, and IIIc–1, nonirrigated; Loamy Plains range site; tree planting suitability group 1.

Weld-Deertrail complex, 0 to 3 percent slopes (WrB).—This complex is on uplands. About 60 percent of it is Weld loam, and 40 percent is Deertrail loam. The Weld soil is similar to Weld loam, 1 to 3 percent slopes, but it is closely intermingled with patches of the Deertrail soil. The patches are bare and commonly are called slickspots.

Areas of the complex in native pasture can be readily recognized by the bare spots that are characteristic of Deertrail soils. These have a growth of bunchgrass or buffalograss around their edges and are surrounded by a cover of grama grasses. In cultivated fields the slickspots are difficult to see in some areas, but they cause crop growth to be stunted and the surface layer to crust.

Much of this complex is dryfarmed, but a large acreage remains in native grass. The main crops are winter wheat and sorghums. Runoff is slow. The hazards of water erosion and soil blowing are moderate, but they increase in severity if gullies form. Soil blowing is a severe hazard if the soils are dryfarmed in years when rainfall is not sufficient. Capability unit IVs–2, nonirr

gated; tree planting suitability group 3. Weld soils, Loamy Plains range site. Deertrail soils, Alkaline Plains range site.

Wet Alluvial Land

Wet alluvial land (Wt) is on the nearly level bottom lands of the larger streams next to stream channels throughout the county. The areas range from 20 to 150 acres in size. This land type is wet most of the time and is flooded by streamflow once to several times a year during periods of high water. Included in mapping are small areas of Loamy alluvial land, moderately wet, a few small sand and gravel bars, and areas underlain by heavy clay, commonly called oxbows.

The materials are extremely variable in texture; they consist of stratified layers of dark-colored silt, loam, and clay. The layers are generally less than 6 inches thick and are underlain by sand, fine sand, and some gravel at depths of 1 to 3 feet. They are wet at a depth of 2 feet most of the time and are commonly wet to the surface throughout the growing season. Natural fertility is moderate to good.

Areas of this land type have a vegetative cover of water-tolerant plants, such as cattails and sedges, and are not suitable for cultivation, because of the hazard of flooding from streams and a high water table. Under improved management, the production of native grass for grazing or hay is good. Generally a few cottonwood trees and willows are present. Capability unit Vw-1, irrigated; Wet Meadow range site; tree planting suitability group 4.

Wiley Series

The Wiley series consists of well-drained, gently sloping to strongly sloping soils on uplands. These soils formed in wind-worked loamy material.

In a representative profile, the surface layer is grayish-brown loam about 3 inches thick. It is noncalcareous. The upper part of the subsoil is slightly calcareous, light brownish-gray loam about 5 inches thick. The lower part of the subsoil is very pale brown loam and very fine sandy loam. This material is highly calcareous; it contains many splotches of visible lime to a depth of about 40 inches, but splotches cannot be seen below that depth.

Wiley soils absorb water at a moderate rate, and the available water capacity is high. Permeability is moderately slow, and the entire soil is suitable for plant roots.

Representative profile of a Wiley loam having a slope of 4 percent, in an area of grass, 1,100 feet east and 100 feet south of the northwest corner of section 18, T. 3 S., R. 57 W.:

A1—0 to 3 inches, grayish-brown (10YR 5/2) loam, very dark grayish brown (10YR 3/2) when moist; weak, fine, platy structure parting to weak to moderate, fine, granular structure; soft, very friable; noncalcareous; mildly alkaline; clear, smooth boundary.

B21t—3 to 8 inches, light brownish-gray (10YR 6/2) clay loam, dark grayish brown (10YR 4/2) when moist; weak, fine to medium, prismatic structure parting to weak, medium, subangular blocky structure; slightly hard, friable; very thin continuous clay films on both faces of peds; calcareous; moderately alkaline; clear, wavy boundary.

B22tca—8 to 13 inches, very pale brown (10YR 7/3) clay loam, brown (10YR 5/3) when moist; very weak, medium, prismatic structure parting to weak, medium, subangular blocky structure; slightly hard, friable; patchy clay films on both faces of peds; calcareous and contains lime disseminated and in common, medium-sized, distinct splotches; moderately alkaline; clear, wavy boundary.

C1ca—13 to 24 inches, very pale brown (10YR 7/3) loam, brown (10YR 5/3) when moist; weak, medium, subangular blocky structure; slightly hard, friable; calcareous and contains lime disseminated and in common, medium-sized, distinct splotches; moderately alkaline; gradual, smooth boundary.

C2ca—24 to 40 inches, very pale brown (10YR 7/3) very fine sandy loam, brown (10YR 5/3) when moist; massive; slightly hard, very friable; calcareous and contains lime disseminated and in common, medium-sized, faint splotches; moderately alkaline; gradual, smooth boundary.

C3—40 to 60 inches, very pale brown (10YR 7/4) very fine sandy loam, yellowish brown (10YR 5/4) when moist; massive; slightly hard, very friable; calcareous; moderately alkaline.

The A horizon ranges from 2 to 5 inches in thickness, from grayish brown to brown in color, and from loam to fine sandy loam in texture. The B horizon ranges from 10 to 24 inches in thickness. Depth to calcareous material ranges from 0 to 8 inches.

Wiley-Adena-Renohill complex, 3 to 20 percent slopes (WuE).—The soils in this complex have intermediate slopes between river terraces or upland drainage channels and the gently sloping soils on uplands.

Wiley loam makes up about 40 percent of the complex; Adena loam, about 35 percent; Renohill loam, about 20 percent; and Loamy alluvial land, nearly 5 percent. Included in mapping are small areas of Colby, Samsil, and Shingle soils. Scattered slickspots also are included.

Adena loam is the smoothest of the major soils. It is at the top of slopes in narrow bands and has slopes of 3 to 5 percent. Wiley loam has somewhat stronger slopes. It adjoins narrow thin ridges of Colby soils that are generally at right angles to the slopes around the brow of the hill or extend downward parallel to the slope as steeper ridges outlining drainage channels. Renohill loam is in the heads of drainageways. Samsil and Shingle soils are at the bottom of the slopes where erosion has exposed the shale and interbedded shale and sandstone. Loamy alluvial land is the fill material in the drainageways.

Some less sloping areas of the complex have been cultivated, but most have been abandoned and allowed to return to grass cover. The soils are not suitable for cultivation, because of the strong slopes and the severe hazard of erosion. Capability unit VIe-1, nonirrigated; Loamy Slopes range site; tree planting suitability group 3.

Use and Management of the Soils

This section consists of several parts. The first discusses the use of soils for cropland. Predicted yields of crops under two levels of management are given for irrigated and nonirrigated soils. Next is a brief explanation of the capability grouping of soils used by the Soil Conservation Service. This is followed by a discussion of the capability units in the county. Also discussed

are use and management of the soils for range, for trees and shrubs, and for wildlife. Uses of the soils in engineering and in community development are then discussed.

Use of the Soils for Cropland [2]

About 515,000 acres of the county are used as cropland. About 155,000 acres are used for irrigated crops and 360,000 acres for nonirrigated crops or summer fallow.

The main irrigated crops are alfalfa, corn, barley, sugar beets, oats, wheat, and rye. Vegetable crops are grown on a large acreage in the western part of the county. Winter wheat, forage sorghum, and barley are the main nonirrigated crops.

Lack of sufficient moisture is the main limitation to crop production in the county. In most years the supply of irrigation water is adequate in most areas. Some areas lack water in the latter part of the growing season. Nonirrigated areas receive only about 14 inches of precipitation annually, and this amount is inadequate for annual cropping. A system of fallowing 1 year and growing crops the next is followed.

Soil blowing is a serious concern of management in the county. Stubble or cover crops are maintained on the surface of erodible irrigated soils through the windy season to control blowing. Maintaining growing crops or adequate residue on the surface of the erodible nonirrigated soils is necessary to control soil blowing. Many farmers practice stubble mulching by using subsurface tillage implements to help maintain residue on the surface of the soil. Delayed and reduced tillage are common practices. Wind and contour stripcropping are used to supplement residue management on erodible soils to control blowing.

Water erosion is active on many of the sloping soils. On irrigated soils ditches are checked, lined, or piped to control washing. Rows are run across the slope in some places, and irrigation heads are reduced to control erosion. Management of irrigation water so that crops receive water as needed without excessive waste requires soil preparation, water control facilities, and careful attention during irrigation. Sprinkler systems are becomming popular for close-drilled crops on the more sloping and undulating, sandy soils. In nonirrigated acres terraces are used to break the sweep of the slope and the soil is contour farmed. Grassed waterways are used for terrace outlets to safely remove excess water.

Predicted yields of principal crops

The predicted average yields per acre of the principal irrigated crops are given under two levels of management in table 2. The yields of nonirrigated crops are given in table 3. These predictions are based on observations over a long period of time and on information obtained from farmers and agricultural leaders of the county. Yields in columns A are those obtained under common management, which does not include regular cropping systems or conservation management. Yields in columns B are those that can be expected under improved management, including planned cropping systems and measures that conserve soil and moisture, maintain high fertility levels, adequate organic-matter content in the soil, and good soil structure.

Soils that are not suitable for producing any of the principal crops are omitted from the tables.

[2] JAMES G. BRUNER, conservation agronomist, Soil Conservation Service, assisted in preparing this section.

Capability Grouping

Capability grouping shows, in a general way, the suitability of soils for most kinds of field crops. The groups are made according to the limitations of the soils when used for field crops, the risk of damage when they are used, and the way they respond to treatment. The grouping does not take into account major and generally expensive landforming that would change slope, depth, or other characteristics of the soils; does not take into consideration possible but unlikely major reclamation projects; and does not apply to rice, cranberries, horticultural crops, or other crops requiring special management.

Those familiar with the capability classification can infer from it much about the behavior of soils when used for other purposes, but this classification is not a substitute for interpretations designed to show suitability and limitations of groups of soils for range, for trees, or engineering.

In the capability system, all kinds of soil are grouped at three levels, the capability class, subclass, and unit. These are discussed in the following paragraphs.

CAPABILITY CLASSES, the broadest groups, are designated by Roman numerals I through VIII. The numerals indicate progressively greater limitations and narrower choices for practical use, defined as follows:

- Class I soils have few limitations that restrict their use.
- Class II soils have moderate limitations that reduce the choice of plants or that require moderate conservation practices.
- Class III soils have severe limitations that reduce the choice of plants, require special conservation practices, or both.
- Class IV soils have very severe limitations that reduce the choice of plants, require very careful management, or both.
- Class V soils are not likely to erode but have other limitations, impractical to remove, that limit their use largely to pasture, range, woodland, or wildlife.
- Class VI soils have severe limitations that make them generally unsuited to cultivation and limit their use largely to pasture, range, woodland, or wildlife.
- Class VII soils have very severe limitations that make them unsuited to cultivation and that restrict their use largely to pasture, range, woodland, or wildlife.
- Class VIII soils and landforms have limitations that preclude their use for commercial plants and restrict their use to recreation, wildlife, or water supply, or to esthetic purposes. (None in Adams County.)

CAPABILITY SUBCLASSES are soil groups within one class; they are designated by adding a small letter, *e*, , *s*, or *c*, to the class numeral, for example, IIe. The letter *e* shows that the main limitation is risk of erosion unless close-growing plant cover is maintained; *w* shows that water in or on the soil interferes with plant growth or cultivation (in some soils the wetness can be partly corrected by artificial drainage); *s* shows that the soil is limited mainly because it is shallow, droughty, or stony; and *c*, used in only some parts of the United States, shows that the chief limitation is climate that is too cold or too dry.

In class I there are no subclasses, because the soils of this class have few limitations. Class V can contain, at the most, only the subclasses indicated by *w*, *s*, and *c*, because the soils in class V are subject to little or no erosion, though they have other limitations that restrict their use largely to pasture, range, woodland, wildlife, or recreation.

CAPABILITY UNITS are soil groups within the subclasses. The soils in one capability unit are enough alike to be suited to the same crops and pasture plants, to require similar management, and to have similar productivity and other responses to management. Thus, the capability unit is a convenient grouping for making many statements about management of soils. Capability units are generally designated by adding an Arabic numeral to the subclass symbol, for example, IIe–2 or IIIe–7. Thus, in one symbol, the Roman numeral designates the capability class, or degree of limitation; the small letter indicates the subclass, or kind of limitation, as defined in the foregoing paragraph; and the Arabic numeral specifically identifies the capability unit within each subclass.

In the following pages the irrigated capability units and then the nonirrigated units in Adams County are described and suggestions for the use and management of the soils are given. The names of soil series represented are mentioned in the description of each capability unit, but this does not mean that all the soils of a given series appear in the unit. To find the names of all the soils in any given capability unit, refer to the "Guide to Mapping Units" at the back of this survey.

Management by irrigated capability units

In this subsection, each irrigated capability unit in Adams County is described and use and management are discussed.

CAPABILITY UNIT I–1, IRRIGATED

The soils in this unit are deep, well-drained, nearly level loams of the Nunn and Satanta series.

These soils are easy to cultivate and absorb water at a moderate rate. They have a moderate to high available water capacity and moderate to moderately slow permeability. The hazard of erosion is slight.

TABLE 2.—*Predicted average yields per acre for the principal irrigated crops under two levels of management*

[Yields in columns A are those to be expected under common management; yields in columns B are those to be expected under improved management. Absence of a yield figure indicates that the crop is not usually grown on this soil]

Soil	Alfalfa		Wheat		Corn		Sugar beets		Corn ensilage		Barley	
	A	B	A	B	A	B	A	B	A	B	A	B
	Tons	*Tons*	*Bu.*	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*	*Tons*	*Tons*	*Bu.*	*Bu.*
Ascalon sandy loam, 1 to 3 percent slopes	3.5	5.5	35	50	85	110	18	24	16	22	35	50
Ascalon sandy loam, 3 to 5 percent slopes	2.5	4.5	30	40	70	90	15	19	12	18	30	40
Ascalon sandy loam, 5 to 9 percent slopes	2.0	4.0	25	35	50	85			9	14	25	35
Ascalon loamy sand, 0 to 3 percent slopes	3.0	5.0	30	45	85	100	16	20	12	18	30	45
Dacono loam, 0 to 1 percent slopes	3.5	5.0	30	50	85	120	18	26	18	26	30	50
Dacono loam, 1 to 3 percent slopes	2.5	4.5	25	40	75	100	16	22	16	24	25	40
Heldt clay, 0 to 3 percent slopes	2.5	5.0	20	35	45	90	14	20	12	20	20	35
Heldt clay, 3 to 9 percent slopes	2.0	3.5	15	25								
Loamy alluvial land, gravelly substratum	1.5	2.5										
Loamy alluvial land, moderately wet	2.0	5.0	30	45	40	100	12	24	12	22	30	45
Nunn loam, 0 to 1 percent slopes	4.0	6.0	40	60	95	125	19	25	20	30	40	60
Nunn loam, 1 to 3 percent slopes	4.0	6.0	35	50	90	120	18	24	19	28	35	55
Nunn clay loam, 0 to 1 percent slopes	3.5	5.5	35	50	90	120	18	24	19	28	35	50
Nunn clay loam, 1 to 3 percent slopes	3.5	5.5	30	45	90	110	17	23	18	26	30	45
Platner loam, 0 to 3 percent slopes	4.0	6.0	35	55	90	120	18	24	16	20	35	55
Platner loam, 3 to 5 percent slopes	3.0	5.0	30	45	80	100	15	18	14	18	30	45
Renohill loam, 3 to 9 percent slopes	1.5	3.5	15	20							15	20
Satanta loam, 0 to 1 percent slopes	4.0	6.0	40	60	95	125	19	25	18	26	40	60
Satanta loam, 1 to 3 percent slopes	4.0	6.0	35	50	90	120	18	24	16	24	35	50
Truckton loamy sand, 0 to 3 percent slopes	2.5	4.5	25	35	60	80	14	18	10	15	25	35
Truckton sandy loam, 1 to 3 percent slopes	3.0	5.0	30	40	70	100	16	21	12	16	30	40
Truckton sandy loam, 3 to 5 percent slopes	2.5	4.5	25	35	60	90			10	15	25	35
Ulm loam, 3 to 5 percent slopes	2.0	3.5	20	40	65	85	13	17	12	14	20	40
Ulm loam, 5 to 9 percent slopes	1.5	3.0	15	25					10	12	15	25
Vona loamy sand, 0 to 3 percent slopes	2.5	4.5	25	35	50	80	14	18	10	15	25	35
Vona sandy loam, 0 to 1 percent slopes	3.5	5.5	35	45	80	100	16	21	14	20	35	45
Vona sandy loam, 1 to 3 percent slopes	3.0	5.0	30	40	80	100	16	21	10	16	30	40
Vona sandy loam, 3 to 5 percent slopes	2.0	4.0	20	25	60	85			9	13	20	25
Weld loam, 1 to 3 percent slopes	4.0	6.0	40	60	90	120	18	24	16	20	40	60

TABLE 3.—*Predicted average yields per acre for dryland crops under two levels of management*

[Yields in columns A are those to be expected under common management; yields in columns B are those to be expected under improv management]

Soil	Winter wheat		Barley		Forage sorghum	
	A	B	A	B	A	B
	Bu.	*Bu.*	*Bu.*	*Bu.*	*Tons*	*Tons*
Adena loam, 0 to 3 percent slopes	15	18	16	19	1.5	3.0
Adena loam, 3 to 5 percent slopes	13	17	14	18	1.0	2.5
Adena-Colby association, gently sloping	11	13	12	14	.5	1.5
Ascalon loamy sand, 0 to 3 percent slopes	13	16	14	17	2.0	3.5
Ascalon sandy loam, 1 to 3 percent slopes	16	19	17	20	2.0	3.5
Ascalon sandy loam, 3 to 5 percent slopes	14	18	15	19	1.0	2.5
Ascalon sandy loam, 5 to 9 percent slopes	11	14	11	14	.5	1.5
Ascalon-Platner association	15	18	16	19	1.5	3.0
Ascalon-Vona sandy loams, 1 to 5 percent slopes	13	16	14	18	1.0	2.5
Heldt clay, 0 to 3 percent slopes	13	15	13	15	.5	1.5
Nunn loam, 1 to 3 percent slopes	16	19	17	20	2.0	4.0
Nunn clay loam, 1 to 3 percent slopes	14	19	15	20	1.5	4.0
Platner loam, 0 to 3 percent slopes	16	19	16	20	2.0	4.0
Platner loam, 3 to 5 percent slopes	14	18	15	19	1.0	2.5
Renohill loam, 1 to 3 percent slopes	12	15	13	16	1.5	3.0
Satanta loam, 1 to 3 percent slopes	16	19	17	20	2.0	4.0
Stoneham loam, 0 to 3 percent slopes	13	16	14	17	1.5	3.5
Terry fine sandy loam, 0 to 3 percent slopes	12	15	13	16	1.0	3.0
Truckton loamy sand, 0 to 3 percent slopes	11	14	11	14	1.5	3.5
Truckton sandy loam, 1 to 3 percent slopes	14	17	15	18	2.0	4.0
Ulm loam, 1 to 3 percent slopes	13	16	14	17	1.5	3.5
Ulm loam, 3 to 5 percent slopes	11	14	12	15	1.0	2.0
Vona loamy sand, 0 to 3 percent slopes	10	13	10	13	1.5	3.0
Vona sandy loam, 1 to 3 percent slopes	13	16	14	17	1.5	3.5
Weld loam, 1 to 3 percent slopes	16	19	17	20	2.0	4.0
Weld-Deertrail complex, 0 to 3 percent slopes	8	12	9	13	1.0	2.0

These soils are suited to the crops commonly grown in the county. Corn, alfalfa, sugar beets, and vegetables are the main crops. Some malting barley and other small grains also are grown.

These soils are suited to most irrigation methods, and a minimum amount of preparation is needed. A suitable crop rotation is needed to maintain good tilth. Fertilizer is needed because the soils are used intensively for crops. Nonlegumes respond to additions of nitrogen and phosphorus, and legumes respond to additions of phosphorus.

CAPABILITY UNIT IIe-1, IRRIGATED

The soils in this unit are deep, well-drained, very gently sloping loams and clay loams of the Nunn, Platner. Satanta, and Weld series.

Most of these soils are easy to cultivate, but the Nunn clay loam should be plowed in fall to make seedbed preparation easier in spring. All the soils absorb water at a moderate rate, have medium to high available water capacity, and are moderate to slow in permeability. The hazard of erosion is moderate.

These soils are suited to all of the crops grown in the county. Unless furrows are angled across the slope, row crops should not be grown for more than 3 consecutive years in the rotation. A good rotation is 3 or 4 years of alfalfa, 1 year each of corn, sugar beets, corn, and small grain, and then back to alfalfa.

Border ditches and furrows tend to wash, but most other irrigation methods work well on these soils. Water applied between borders is difficult to control on these slopes and borders should not be used unless the soils are bench bordered. Flooding between contour ditches is suitable for alfalfa and small grain crops. Regulated furrows and contour furrows are best for row crops. Reducing irrigation heads and lengths of run somewhat from those used on more nearly level soils helps to control erosion and to reduce the amount of waste water. High-residue crops, reduced tillage, and extra manure help to improve tilth and the water-intake rate. Crops respond well to fertilizers applied in amounts indicated by soil tests.

CAPABILITY UNIT IIe-2, IRRIGATED

Ascalon sandy loam, 1 to 3 percent slopes, is the only soil in this unit. It is deep, well drained, and very gently sloping.

This soil is easy to cultivate and absorbs water at a moderately rapid rate. It has medium available water capacity and moderate permeability. The hazards of soil blowing and water erosion are slight to moderate.

This soil is suited to all of the crops grown in the county. It is especially suited to intensive cropping, but adequate irrigation water is needed, and the soil should be leveled if row or truck crops are grown. A good rotation is 1 year each of alfalfa, corn, sugar beets, corn, and small grain, and then back to alfalfa.

Ridges or other areas exposed to strong winds and blowing can be protected by leaving ample amounts of stubble throughout the windy season, or by leaving th surface rough or ridged. Reducing irrigation heads an

lengths of run from those used on more nearly level soils helps to control erosion and reduces unequal water penetration. Border ditches erode, but suitable irrigation methods are border dikes, sprinklers, and, for corn, furrow irrigation. Crops generally respond to additions of nitrogen and phosphorus applied in amounts indicated by soil tests.

CAPABILITY UNIT IIs–1, IRRIGATED

Nunn clay loam, 0 to 1 percent slopes, is the only soil in this unit. It is deep, well drained, and nearly level.

This soil is slightly difficult to cultivate. It is easier to work for a seedbed if it is plowed in fall. Occasional subsoiling when the soil is dry temporarily opens the soil to air, water, and plant roots. It should not be tilled when wet. It absorbs water at a moderately slow rate, has high available water capacity, and is slow in permeability. The erosion hazard is slight.

This soil is suited to all of the crops grown in the county. It needs deep-rooted and high-residue crops to open the soil for air and water penetration.

Suitable irrigation methods are border dikes, border ditches, and furrows. Lengths of run for borders can be long, up to half a mile, but irrigation frequency needs to be increased in places because this method does not wet the soil deeply enough. Furrows that have small streams that run for a long time work well. Crops respond to additions of nitrogen and phosphorus. Barnyard manure or green manure is especially good because it helps to maintain organic matter as well as plant nutrients.

CAPABILITY UNIT IIs–2, IRRIGATED

Vona sandy loam, 0 to 1 percent slopes, is the only soil in this unit. It is deep, well drained, and nearly level.

This soil is easy to cultivate and absorbs water at a moderately rapid rate. It has medium to moderately low available water capacity and moderately rapid permeability. The erosion hazard is slight.

This soil is suited to all the crops grown in the county. Crop rotations based on alfalfa or grass and high-residue crops help control soil blowing and add organic matter. This soil supports intensive row or truck-crop farming, but soil blowing needs to be controlled.

Reducing lengths of irrigation runs and using nonerodible heads of water help to irrigate without overirrigating the upper ends of fields. The system should allow for frequent irrigation. Some crops need water once a week. Borders, controlled flooding, furrows, and sprinklers are suitable irrigation methods. Sprinklers work well and is the most efficient method for irrigating this soil. If the soil is used intensively for crops, additions of nitrogen and phosphorus, as well as manure, are needed and high-residue crops should be used in the rotation to maintain fertility and good tilth. Nitrogen generally is applied when corn or sugar beets are grown; phosphorus is used before sugar beets or alfalfa are grown.

CAPABILITY UNIT IIIe–1, IRRIGATED

The soils in this unit are deep, well-drained, gently sloping loams of the Platner and Ulm series.

These soils are easy to cultivate and absorb water at moderate rate. They have medium to high available water capacity and slow to moderately slow permeability. The water erosion hazard is moderate to severe.

These soils are suited to most of the crops grown in the county. Onions, tomatoes, and vine crops are not well suited. Row crops should not be grown more than 2 years in succession unless the soils are leveled and furrows are angled across the slope. The soils are too steep for intensive row cropping or truck farming. The rotation should include alfalfa and a small grain to provide the protection of a growing cover and surface residue.

Border irrigation is not suited to these soils. Because the water moves too fast between borders, not enough water is absorbed, the soil erodes, and water is wasted at the lower end of the field. Sprinklers work on soils used for hay or pasture. Closely spaced contour ditches allow controlled flooding for drilled crops, and short furrows or longer contour furrows can be used for row crops. Lengths of run need to be relatively short, so that small, nonerosive amounts of water can be used. Nitrogen and phosphorus should be applied in amounts indicated by soil tests to achieve desired production levels.

Pasture is well suited on these soils and helps to control erosion if well managed. Bromegrass, fescue, and orchardgrass mixed with alfalfa or clover make productive pasture.

CAPABILITY UNIT IIIe–2, IRRIGATED

Dacono loam, 1 to 3 percent slopes, is the only soil in this unit. It is well drained, very gently sloping, and moderately deep to sand and gravel.

This soil is easy to cultivate and absorbs water at a moderate rate. It has medium to moderately low available water capacity and slow permeability. The hazard of water erosion is moderate.

This soil is suited to most of the crops grown in the county, but onions, tomatoes, and vines do not produce well on the stronger slopes. Continuous intensive row cropping or truck cropping requires leveling and is limited because the soil is shallow. Row crops planted downslope should not be grown for more than 2 years in succession. Growing alfalfa and small grain in the rotation reduces erosion losses. The growth of alfalfa is limited by the moderately shallow soil.

Border, contour ditch, and sprinkler methods of irrigation can be used for drilled crops; and furrow and contour furrow methods can be used for row crops. Lengths of runs need to be fairly short to reduce the amount of waste water from overirrigation. Irrigation heads should be small to control erosion. Crops respond to use of manure and fertilizers, especially nitrogen and phosphorus.

Permanent grass for pasture or hay is well suited to these soils. Bromegrass, orchardgrass, and fescue mixed with alfalfa or clover make long-lived, productive pastures.

CAPABILITY UNIT IIIe–3, IRRIGATED

The soils in this unit are deep, well-drained, gently sloping sandy loams of the Ascalon, Truckton, and Vona series.

Ascalon and Vona soils are easy to cultivate, but the Truckton soil is very hard when dry. All of these soils absorb water at a moderately rapid rate, have medium to moderately low available water capacity, and are

moderate to rapid in permeability. The hazards of soil blowing and water erosion are moderate to severe.

These soils are suited to most of the crops grown in the county. The soils are too sloping for continuous row crops or truck crops. Onions, vines, and tomatoes are not generally well suited. Alfalfa and small grain are needed in the rotation to reduce soil washing and blowing. Rows should be angled across the slope if corn or sorghum is grown, or these crops should not be grown more than 2 consecutive years in the rotation. Reduced or minimum tillage helps to control water erosion and soil blowing by keeping residue near the surface.

Border irrigation is not suitable. The soils are so sloping that water does not spread. Sprinkling or flooding from contour ditches is a good method for irrigating drilled crops and pasture. Row crops should be irrigated by use of furrows, contour furrows, or sprinklers. Irrigation runs need to be short so that small, nonerosive streams can be used. Crops respond to addition of nitrogen and phosphorus applied in amounts indicated by soil tests. The extra crop growth helps to control erosion.

Permanent grass for pasture or hay is well suited and helps to protect the soil from soil blowing and water erosion. Smooth brome, orchardgrass, or fescue mixed with alfalfa or clover make long-lived, productive pasture. Good management, high fertility, and frequent irrigation are necessary for productive pasture.

CAPABILITY UNIT IIIe-4, IRRIGATED

The soils in this unit are deep, well-drained, very gently sloping sandy loams of the Truckton and Vona series.

The Vona soil is easy to cultivate, but the Truckton soil is hard to cultivate when dry. Both soils absorb water at a moderately rapid rate. They have medium to moderately low available water capacity and moderately rapid to rapid permeability. The hazard of soil blowing is moderate to severe.

These soils are suited to all the crops grown in the county. If the soils are leveled, however, crop rows should be slanted across the slope. Row crops should not be grown more than 2 consecutive years in the cropping sequence.

Irrigation runs need to be short, and some crops need to be irrigated as often as once a week. Crops respond to additions of manure and fertilizer. Manure increases the available water capacity, adds plant nutrients, and provides some erosion control. Nitrogen is commonly applied annually to soils used for corn. Phosphorus is often applied before hay or pasture is planted.

These soils are suited to irrigated pasture. Bromegrass, orchardgrass, and fescue mixed with alfalfa or clover make good pasture.

CAPABILITY UNIT IIIe-5, IRRIGATED

The soils in this unit are deep, well-drained, nearly level to very gently sloping loamy sands of the Ascalon, Truckton and Vona series.

These soils are easy to cultivate and absorb water rapidly. They have moderately low to low available water capacity and are moderate to rapid in permeability. The hazard of soil blowing is moderate to severe.

These soils are suited to most of the crops grown in the county, but onions, tomatoes, and vines do not grow well. Row crops should not be grown unless protective residue is left on the surface or a winter crop established to protect the soil from blowing. Alfalfa, corn for grain and small grain make a good rotation.

Irrigation runs must be short. Frequent irrigations are needed. Sprinkling is an effective method of irrigation. The sprinklers should be self powered or easily moved because some crops need irrigating as often as once every 5 days. Border irrigation, using short runs and large amounts of water, is suitable for hay and pasture on the more gently sloping soils. Applications of nitrogen and phosphorus, as well as manure or crop residue, are needed annually to keep the soils productive.

Permanent pasture or hay is well suited. Good management, including frequent application of irrigation water and additions of fertilizer, is needed for productive pasture. Permanent vegetation makes irrigation easier and helps to control erosion. Bromegress, orchardgrass, and fescue mixed with alfalfa and clover make good pasture.

CAPABILITY UNIT IIIs-1, IRRIGATED

Heldt clay, 0 to 3 percent slopes, is the only soil in this unit. It is deep, well drained, and nearly level to very gently sloping. This soil forms cracks when dry, but these swell shut rapidly when water is applied. The soil tends readily to become saline because it is derived from shale.

This soil is hard to cultivate and absorbs water slowly. It has high available water capacity and slow permeability. The erosion hazard is slight.

This soil is better suited to close-growing crops than to row crops or truck crops. Potatoes will not do well. Continuous row crops or truck crops are not suited, because they do not produce the residue needed to keep the soil open to air, water, and plant roots. Excessive cultivation compacts the surface layer and hastens the loss of organic matter. A good rotation consists of alfalfa, corn, and small grain; or alfalfa, corn, sugar beets, and small grain.

Pasture is well suited. Bromegrass, wheatgrass, or fescue, or two or more of these grasses, mixed with alfalfa and clover make long-lasting mixtures that can be used for pasture and hay.

Irrigation runs can be relatively long, but care must be taken not to overirrigate. Borders, corrugations, and contour ditches are suitable irrigation methods for drilled crops. Furrow irrigation is used for row crops. Sprinklers are not suitable. Time between irrigations can be long for some crops. Long runs are generally needed to wet the root zone. Crops respond to nitrogen and phosphorus. Manure and crop residue are especially good for this soil and help to keep it more open and workable.

CAPABILITY UNIT IIIs-2, IRRIGATED

Dacono loam, 0 to 1 percent slopes, is the only soil in this unit. It is well drained, nearly level, and moderately deep to sand and gravel.

This soil is easy to cultivate and absorbs water at a moderate rate. It has medium to moderately low available water capacity and slow permeability. The erosion hazard is slight.

This soil is suited to almost all the crops grown in the county, but it is not suited to very deep rooted crops. Intensive row cropping or truck farming should include

the use of manure, green manure, fertilizer, and special residue crops to maintain fertility, crop growth, and good tilth.

Border and sprinkler irrigation are good methods for drilled crops. Furrow and sprinkler irrigation are used for row crops. Runs can be fairly long, but time of irrigation should be short to control overirrigation, seepage, and plant nutrient losses. Some crops need to be irrigated as often as once a week.

Permanent pasture or hay is a good use for this soil. Bromegrass, orchardgrass, and fescue mixed with alfalfa and clover make long-lived, productive pasture.

CAPABILITY UNIT IIIw-1, IRRIGATED

This unit consists only of Loamy alluvial land, moderately wet. This land type is deep, somewhat poorly drained, and nearly level.

This land is easy to cultivate and absorbs water at a moderate rate. It has medium to high available water capacity and moderate to moderately slow permeability. The erosion hazard is slight to moderate, and the hazard of flooding is moderate to severe.

This land type is suited to most of the crops grown in the county. A good cropping system is 3 or 4 years of alfalfa, 1 year each of corn, small grain, sugar beets, and grain, and then back to alfalfa. Irrigated pastures are especially well suited. Bromegrass, orchardgrass, and fescue mixed with alfalfa or clover make long-lived, productive irrigated pasture.

Most irrigation methods are suitable after leveling, subsurface drainage, and flood protection have been applied to the area. Drilled crops can be irrigated by controlled flooding, by border dikes or ditches, or by gated pipes. Row crops can be irrigated by furrows or sprinklers. Lengths of irrigation runs vary with the kind of crop and the degree of subsurface drainage. Crops respond to application of nitrogen and phosphorus if this land type is carefully managed. Management of crop residue and application of barnyard manure aid in maintaining good tilth.

CAPABILITY UNIT IVe-1, IRRIGATED

The soils in this unit are moderately deep to deep, well-drained, gently sloping to moderately sloping loams and clays of the Heldt, Renohill, and Ulm series. These soils tend readily to become seeped and saline because they overlie shale or were derived from shale.

Renohill and Ulm soils are easy to cultivate and absorb water at a moderate rate. They have medium to high available water capacity and are moderately slow to slow in permeability. The Heldt soil is difficult to cultivate and absorbs water slowly. It has high available water capacity and is slow in permeability. On all the soils, the hazard of water erosion is moderate to severe.

These soils are suitable for limited cropping, but intensive cropping is hazardous. A good cropping system is alfalfa in a rotation with small grain or irrigated pasture.

Sprinklers and closely spaced contour ditches are the best irrigation methods. Permanent contour ditches or sprinklers can be used if these soils are in permanent pasture or hay. Crops generally respond to additions of manure, nitrogen, and phosphorus and help to produce e vegetative growth needed to control erosion.

Permanent pasture or hay helps to protect these soils and commonly is the most profitable way to use them. Irrigation is simpler in pasture than in fields used for crops. Bromegrass, orchardgrass, fescue, and wheatgrass mixed with alfalfa or clover, or both, make a long-lived, productive pasture. Rotation use, limited grazing (leave 4 inches of stubble), adequate water, and fertilizer are all needed to maintain productive pasture that protects the soils from erosion.

CAPABILITY UNIT IVe-2, IRRIGATED

Ascalon sandy loam, 5 to 9 percent slopes, is the only soil is this unit. It is deep, well drained, and moderately sloping.

This soil is easy to cultivate and absorbs water at a moderately rapid rate. It has medium available water capacity and moderate permeability. The erosion hazard is severe.

This soil is suitable for limited cropping, but it is not suited to row crops. A suitable cropping sequence is alfalfa in a rotation with small grain or irrigated pasture.

Irrigation methods are limited to closely spaced contour ditches and sprinklers. Extreme care is needed for the irrigation of all crops to keep the soil from eroding.

Permanent pasture or hay is suited to this soil. It makes irrigation easier and helps to control erosion because of the permanent cover. Bromegrass, orchardgrass, and fescue mixed with alfalfa or clover makes productive pasture. Good management requires rotation of use to permit watering and regrowth. Fertilizer and adequate water are needed for productive pasture.

CAPABILITY UNIT IVw-1, IRRIGATED

This unit consists only of Loamy alluvial land, gravelly substratum. It is shallow, well drained to somewhat poorly drained, and nearly level. Small areas of gravel and sand outcrops are scattered throughout.

This land type is easy to cultivate and absorbs water at a moderate rate. It has low available water capacity and rapid to very rapid permeability. The erosion hazard is only slight, but the hazard of flooding is very severe.

This land type is suitable for limited or special cropping, such as use for truck crops. Irrigated pasture also is suited to this land type. Wheatgrass, tall fescue, and adapted clovers are suitable species.

Furrow and sprinkler irrigation are suitable methods of water application. Very intensive management is required to keep this land type productive. Large applications of barnyard manure and fertilizer are needed when producing truck crops, such as head lettuce, table carrots, green onions, cabbage, celery, and other suited crops.

CAPABILITY UNIT Vw-1, IRRIGATED

This unit consists only of Wet alluvial land. The soil material in this land type is shallow to deep, very poorly drained, nearly level, and stratified. Old oxbows underlain by clay are also in areas mapped as this land type. The erosion hazard is only slight, but the flood hazard is severe.

This land type is too wet for cultivation. It is suited to permanent hay or pasture. Seeding is difficult, but

broadcasting and dragging to cover the seed are successful in some places. Bromegrass, wheatgrass, orchardgrass, fescue, and clover make a good mixture for pasture. Use should be rotated to allow regrowth periods and limited to keep the plants in a healthy condition. Although erosion is not a hazard, 3 inches of growth left after use generally improves the stand and the production.

Suitable irrigation methods are sprinklers and flooding, but generally this land type does not need irrigation. Subsurface drainage is not generally feasible, but drainage can be improved in some areas. This land is commonly irrigated by use of tail waste or "free" water. Good management of water and fertilizer is necessary for highly productive pasture.

Management by nonirrigated capability units

In this subsection, each nonirrigated capability unit in the county is described and use and management of the soils are discussed. The Arabic numerals are not consecutive, because not all of the capability units used in Colorado are represented in Adams County.

CAPABILITY UNIT IIIe-6, NONIRRIGATED

Platner loam, 3 to 5 percent slopes, is the only soil in this unit. It is deep, well drained, and gently sloping.

This soil is easy to cultivate, and it absorbs water at a moderate rate. It has medium to high available water capacity and slow permeability. The hazards of soil blowing and water erosion are moderate.

This soil is suited to all adapted crops. For a wheat-fallow sequence, contour or cross-slope stripcropping should be combined with use of crop residue or the soil should be stubble mulched to control water erosion and soil blowing. Terracing and contour planting help to control erosion, especially if row crops are a regular part of the crop sequence.

CAPABILITY UNIT IIIe-7, NONIRRIGATED

The soils in this unit are deep, well-drained, nearly level sandy loams of the Ascalon and Truckton series.

The Ascalon soil is easy to cultivate, but the Truckton soil is hard to cultivate when dry. They both absorb water at a moderately rapid rate, have medium available water capacity, and are moderate to moderately rapid in permeability. The hazard of soil blowing is severe.

These soils are suited to all adapted crops. In a wheat-fallow sequence, use of crop residue or stubble mulching helps to control soil blowing. If row or cultivated crops are grown, these soils need to be stripped against the wind and stubble mulched. To reduced the hazard of soil blowing, annual sorghums can be planted without any seedbed preparation in stubble from the previous year.

These soils commonly respond to nitrogen in years that have sufficient rainfall.

CAPABILITY UNIT IIIs-3, NONIRRIGATED

Nunn clay loam, 1 to 3 percent slopes, is the only soil in this unit. It is deep, well drained, and very gently sloping.

This soil is slightly difficult to cultivate, and it absorbs water at a moderately slow rate. It has high available water capacity and slow permeability. The hazards of soil blowing and water erosion are moderate.

This soil is suited to all adapted crops. Crop residue management or stubble mulching is needed to protect this soil from soil blowing and water erosion. Terracing helps control erosion and conserve water for crops. Sorghums are not well suited to this clayey soil. Stubble mulching and use of crop residue aid in opening the surface soil to improve water infiltration and help maintain good tilth.

This soil is moderately to highly productive. The production is directly proportional to the moisture received. If runoff is saved and held on this soil, crop growth is improved.

CAPABILITY UNIT IIIc-1, NONIRRIGATED

The soils in this unit are deep, well-drained, nearly level to gently sloping loams of the Nunn, Platner, Satanta, and Weld series.

These soils are easy to cultivate, and they absorb water at a moderate rate. They have medium to high available water capacity and moderate permeability. The hazard of water erosion is only slight.

These soils are suited to all adapted crops. A wheat-fallow sequence using crop residue or stubble mulching makes a good conservation cropping system. Sorghums for feed or hay can be used as catch crops in case of hail or loss of stand or for other reasons.

These are some of the most productive nonirrigated soils in the county. They require simple management and erosion control practices. Most areas of these soils are used for crops, but a smaller acreage remains in native grass.

Terracing helps to reduce runoff and to increase the amount of water available for crop growth.

CAPABILITY UNIT IVe-3, NONIRRIGATED

The soils in this unit are moderately deep to deep, well-drained, nearly level to gently sloping loams of the Adena, Renohill, Stoneham, and Ulm series.

These soils are easy to cultivate, and they absorb water at a moderate rate. They have medium available water capacity and slow to moderate permeability. The hazards of soil blowing and water erosion are slight to severe.

These soils are suited to most adapted crops, but intensive care and management are needed in cropped areas and good management is needed in native grassland or planted pasture to control erosion. The cropping sequence is limited to wheat-fallow with wind stripping and stubble mulching. Sorghums are not well suited to these soils, but they can be planted following hail- or wind-damaged wheat crops, and they produce good feed if adequate rain is received. This plant growth helps to protect these soils from erosion. Keeping residue on or near the surface of the soil by minimum tillage or stubble mulching also helps protect the soil and aids in keeping the surface porous for good water infiltration and maintaining good tilth. Terracing and wind stripping help to retain moisture and increase production.

These soils are good for native grassland but are only fair for planted pasture. The native blue grama is a good grass, but its normal production is low. Deteriorated stands can be renewed by careful chiseling and reseeding. Side-oats grama is good in some areas.

Planted pastures are only moderate to low producers of such grasses as crested wheatgrass, intermediate wheatgrass, and, in some areas, western wheatgrass. Most plants do well in years that have sufficient rainfall, but they are damaged in years that have moderate or low rainfall.

CAPABILITY UNIT IVe-4, NONIRRIGATED

The soils in this unit are deep, well-drained, gently sloping loams of the Adena and Ulm series and an Adena-Colby association.

These soils are easy to cultivate, and they absorb water at a moderate rate. They have medium available water capacity and slow to moderate permeability. The hazards of water erosion and soil blowing are severe.

These soils are suitable for limited cropping, but intensive management is needed to control erosion. Structural practices, such as terraces or diversion ditches, or both, also help to control erosion.

The cropping sequence is largely limited to wheat and fallow. Stripping at right angles to the prevailing wind helps to control erosion and conserve moisture. Sorghums are not well suited to these soils, but they can be planted as a catch crop following hail- or wind-damaged wheat crops. This helps to control erosion, and some feed is harvested in places.

This is good native grassland, and it responds to good grassland management. Good pasture grasses are crested wheatgrass, western wheatgrass, and side-oats grama.

CAPABILITY UNIT IVe-5, NONIRRIGATED

The soils in this unit are moderately deep to deep, well-drained, nearly level to very gently sloping sandy loams and fine sandy loams of the Terry and Vona series.

These soils are easy to cultivate, and they absorb water at a moderately rapid rate. These have moderately low available water capacity and moderately rapid permeability. The hazard of water erosion is slight to moderate, and that of soil blowing is severe.

These soils are suitable for limited cropping. Wheat-fallow and wheat-fallow-sorghum-fallow are the main cropping sequences. Good management is necessary to control erosion. Stripping fallow at right angles to the prevailing wind is important. Crop residue left on the surface by using minimum tillage or stubble muching also helps to reduce erosion, increase moisture retention, and control weeds.

This is good grassland or pastureland. Sandyland grasses, such as sandreed, big and little bluestems, sand bluestem, and sand dropseed, are native to these soils. Good introduced pasture grasses include sand lovegrass and crested wheatgrass.

CAPABILITY UNIT IVe-6, NONIRRIGATED

Ascalon sandy loam, 5 to 9 percent slopes, is the only soil in this unit. It is deep, well drained, and moderately sloping.

This soil is easy to cultivate, and it absorbs water at a moderately rapid rate. It has medium available water capacity and moderate permeability. The hazards of soil blowing and water erosion are severe.

This soil is suitable for only limited cropping, but it very good grassland. Wheat-fallow or sorghum-fallow is a suitable cropping sequence, but intensive management is necessary to control erosion. Stripping at right angles to the slope or to the prevailing wind, or both, or stripping on the contour help to control erosion. Crop residue should be left on the surface by stubble muching to control erosion and conserve moisture.

The best use for this soil is permanent pasture or native grassland. Native grasses include big and little bluestems, sandreed, sand bluestem, sand dropseed, and, in some areas, blue grama.

CAPABILITY UNIT IVe-7, NONIRRIGATED

The soils in this unit are deep, well-drained, gently sloping sandy loams and loamy sands of the Ascalon series and the Ascalon-Vona complex.

These soils are easy to cultivate, and they absorb water at a moderately rapid rate. They have medium to moderately low available water capacity and slow to rapid permeability. The hazards of water erosion and soil blowing are moderate to severe.

These soils are suitable for most crops adapted to this county. Intensive management practices are necessary to control erosion. Wheat-fallow and sorghum-fallow are suitable cropping systems. Stripping at right angles to slopes, to the prevailing wind, or both, is a good practice. Carefully designed terraces or diversion dikes also help to control erosion and conserve moisture. In all instances, stubble mulching and use of crop residue help to control erosion, increase moisture intake, and maintain fertility and good tilth.

These soils are excellent for native grassland or planted pasture. The soils produce large amounts of native grasses, such as sandreed, sand bluestem, big and little bluestems, sand dropseed, and blue grama.

CAPABILITY UNIT IVe-8, NONIRRIGATED

Vona loamy sand, 0 to 3 percent slopes, is the only soil in this unit. It is deep, well drained, and nearly level to very gently sloping.

This soil is easy to cultivate, and it absorbs water rapidly. It has moderately low available water capacity and rapid permeability. The hazard of soil blowing is moderate to severe.

This soil is suitable for limited cropping. Wheat-fallow and sorghum-fallow are suitable cropping sequences in years that have sufficient moisture. If cropped, this soil needs intensive conservation management to control erosion. Stubble mulching and wind stripcropping help to control erosion, conserve moisture, and maintain fertility and good tilth.

This soil is excellent grassland. It is well suited to native sandyland grasses if management is good. Old fields can be reseeded with sand lovegrass.

CAPABILITY UNIT IVe-9, NONIRRIGATED

The soils in this unit are deep, well-drained, nearly level to gently sloping loamy sands of the Ascalon and Truckton series.

These soils are easy to cultivate, and they absorb water rapidly. They have medium to moderately low available water capacity and moderate to moderately rapid permeability. The hazard of soil blowing is severe.

These soils are suited to most adapted crops in the county. Intensive management is necessary to control

erosion. Wheat-fallow and sorghum-fallow are the main cropping sequences. Strip-fallow plantings and stubble mulching help to control erosion, conserve moisture, and maintain good tilth.

Using these soils for permanent grass helps to control soil blowing. The soils produce large amounts of sandy-land grasses, such as big bluestem, sandreed, sand bluestem, and sand dropseed. Sand lovegrass is a good introduced pasture grass.

CAPABILITY UNIT IVs-2, NONIRRIGATED

This unit consists of the Weld-Deertrail complex, 0 to 3 percent slopes. The soils in this complex are deep, well-drained, nearly level to very gently sloping loams. The Deertrail soil is alkali affected and characterized by barren slickspots.

Weld loam is easy to cultivate, and it absorbs water at a moderate rate. It has medium to high available water capacity and slow permeability. Deertrail loam is difficult to cultivate, and it absorbs water very slowly. It has low available water capacity and slow permeability. The hazard of water erosion is moderate, and that of soil blowing is severe.

Soils of this complex are suited to some crops but are especially suited to permanent grass. In a wheat-fallow sequence, residue must be kept on or near the surface by minimum tillage. Crop residue management or stubble mulching helps to open the surface layer and increase the water-intake rate. The soils generally are not well suited to grain sorghum and corn, but they are well suited to native grasses, including blue grama, western wheatgrass, and alkali sacaton.

Good grasses for permanent pasture plantings are crested wheatgrass, intermediate wheatgrass, western wheatgrass, and Russian wildrye. Yellow sweetclover does well; it adds nitrogen to the soil and increases the value of the forage. Sweetclover roots help water infiltration and permeability. Good pasture, properly used and managed, is the best use of these soils.

CAPABILITY UNIT IVs-3, NONIRRIGATED

Heldt clay, 0 to 3 percent slopes, is the only soil in this unit. It is deep, well drained, and nearly level to very gently sloping.

This soil is difficult to cultivate, and it absorbs water slowly. It has high available water capacity, but much of the water that could be stored for plant use is lost through runoff. It is slow in permeability. The erosion hazard is only slight.

This soil is suited to only a few crops. It requires much organic matter to aid surface intake of water. Intensive management is needed.

Under good management, this soil is good rangeland. Western wheatgrass and blue grama are the main grasses that furnish good grazing for cattle. Grazing should be controlled so that stock are not in the area when it is wet, to prevent puddling the soil. Frequent rest periods help to maintain a vigorous stand of grass.

CAPABILITY UNIT VIe-1, NONIRRIGATED

The soils in this unit are moderately deep to deep, well-drained, gently to strongly sloping loams of the Renohill, Stoneham, and Ulm series, of an Adena-Colby association, and of the Wiley-Adena-Renohill complex. Included is Loamy alluvial land along associated wate ways.

These soils absorb water at a moderate rate. They have medium available water capacity, but much of the water that would be available for plants is lost through runoff because of slope. The soils have moderate to slow permeability. The erosion hazard is severe.

These soils are not suitable for cultivation, because of the strong, uneven slopes. Cultivated areas should be reseeded to grass. A good seedbed is needed if a stand of grass is to be established. Grazing animals should be excluded until the grass is well established.

Native vegetation includes blue grama and western wheatgrass.

CAPABILITY UNIT VIe-2, NONIRRIGATED

The soils of this unit are shallow to deep, well-drained, gently sloping to moderately steep loams of the Colby series and the Shingle-Renohill complex.

These soils absorb water at a moderate rate. They have low to medium available water capacity, but much of the water that would be available for plants is lost through runoff because of the moderately steep slopes. These soils are moderate to slow in permeability. The erosion hazard is moderate to severe.

These soils are not suitable for cultivation, because of steep, uneven slopes. A few areas are cultivated. Some old fields have been returned to grass. All of these soils are unstable and highly erodible. Areas now cultivated should be reseeded to permanent grass. A stubble crop is needed to stabilize the soils before reseeding. Grazing animals should be excluded until the grass is well e tablished.

Native vegetation includes blue grama, side-oats grama, and western wheatgrass.

CAPABILITY UNIT VIe-3, NONIRRIGATED

Heldt clay, 3 to 9 percent slopes, is the only soil in this unit. It is deep, well drained, and gently sloping to moderately sloping.

This soil absorbs water slowly. It has high available water capacity, but because the soil swells tight if it becomes wet, most of the water that would be available for plants is lost through excessive runoff. Permeability is slow. The hazard of water erosion is moderate to severe.

This soil is not suitable for cultivation unless it is irrigated. The soil is used for grazing.

Native vegetation is western wheatgrass and blue grama.

CAPABILITY UNIT VIe-4, NONIRRIGATED

The soils in this unit are shallow to deep, well-drained, gently sloping to strongly sloping sandy loams, fine sandy loams, and loamy sands of the Terry, Truckton, and Vona series and the Terry-Tassel-Ulm, Terry-Vona-Tassell, and Vona-Ascalon complexes.

These soils absorb water at a moderately rapid to rapid rate, they have moderate to low available water capacity, and they are moderately slow to rapid in permeability. The erosion hazard is moderate to severe.

These soils are not suitable for cultivation, because of moderately steep, uneven slopes. Cultivated areas shou be returned to grass. Small, severely eroded areas are in

fields that formerly were cultivated. Establishing a good grass cover is sometimes difficult. A good stubble crop should be grown to stabilize the soils before they are reseeded to grass. The new seedlings should be protected from grazing until well established.

Native vegetation includes sandreed, sand bluestem, big bluestem, little bluestem, and sand dropseed.

CAPABILITY UNIT VIe-5, NONIRRIGATED

The soils in this unit are deep, somewhat excessively drained, very gently sloping to strongly sloping loamy sands of the Blakeland and Valent series and the Blakeland-Truckton association.

These soils absorb water rapidly; they have low available water capacity and moderately rapid to very rapid permeability. The hazard of soil blowing is severe.

These soils are not suitable for cultivation, because of dominantly stony, uneven slopes. They are used for grazing.

Native vegetation includes prairie sandreed, sand bluestem, switchgrass, little bluestem, blue grama, and sand dropseed. Sand sagebrush and yucca are in places.

CAPABILITY UNIT VIIe-1, NONIRRIGATED

This unit consists only of Gullied land. This land absorbs water at a moderate to slow rate, and the available water capacity is low to medium. Some stored water is not available to plants.

Areas of this mapping unit have been severely damaged by gully and sheet erosion. The scars in these strongly sloping swales have begun healing under good management and favorable moisture periods to such extent that a fair to good grass cover is becoming reestablished. None of this land type is suitable for cultivation. It has fair to good potential as grassland. Machinery generally cannot be used for seedbed preparation, because the areas are too rough or too steep. Some water diversions can be placed at the upper ends of the swales to help remove the hazard of gullying.

Severe restrictions on grazing, as well as timely grazing, help to restore a better stand of native grasses to form a much needed sod cover.

CAPABILITY UNIT VIIe-3, NONIRRIGATED

This unit consists only of Terrace escarpments. The materials in this land type are very shallow gravelly loams underlain by thick deposits of sand and gravel that are calcareous in places. Slopes range from 1 to 80 percent.

This land absorbs water at a moderate to rapid rate, has moderately low to low available water capacity, and has rapid to moderate permeability. Surface runoff is medium to very rapid, and the erosion hazard is moderate to very severe.

Terrace escarpments are too shallow, too gravelly, or too steep for cultivation. They are better suited to grassland, but grass is difficult to reestablish. Machinery generally cannot be used for preparing a seedbed or for seeding because these areas are rough, gravelly, and steep. Good management of the present cover and hand seeding at the proper time are suitable methods of improving the stand.

Native grasses include blue grama, western wheatgrass, slender wheatgrass, and little bluestem.

CAPABILITY UNIT VIIe-6, NONIRRIGATED

The soils in this unit are shallow, well-drained, gently sloping to steep clays of the Samsil and Shingle series.

These soils absorb water at a slow to moderate rate. They have low available water capacity, and stored water is not readily available to plants other than grasses. They are slow to moderate in permeability. Runoff is rapid, and the hazards of sheet and gully erosion are very severe if these soils are cultivated or overgrazed.

Good grazing management is needed to improve and maintain the production of grass. Native grasses include western wheatgrass, blue grama, and little bluestem.

CAPABILITY UNIT VIIw-1, NONIRRIGATED

This unit consists only of Sandy alluvial land. This land type consists mainly of sandy and gravelly materials deposited by streams. It is immediately adjacent to stream channels.

Sandy alluvial land is not suitable for cultivation, because it is too droughty and receives very frequent, damaging floodwater and detrimental deposition during wet periods. In places it is bare of vegetation, but in other places a sparse cover of grasses, shrubs, and cottonwood trees is present. The sparse grassy cover has some grazing value at times, but the land as a whole is unsuitable for regular grazing. Little if any improvements can be made because of the hazard of flooding. The trees and shrubs are of some value to livestock as protection from winter storms and, in summer, for the shade they afford.

CAPABILITY UNIT VIIs-1, NONIRRIGATED

Only Rough broken land is in this unit. It consists of very shallow and shallow, loamy soils that are underlain by, or are between, outcrops of fine-grained sandstone and shale. Slopes are variable and range from 6 to 90 percent.

Runoff is rapid, and the hazard of water erosion is severe. This land absorbs water at a moderate to rapid rate, but runoff from bare sandstone is sometimes very rapid and causes gullies or sheet erosion on lower lying soils.

The soils in Rough broken land are too shallow, too steep, or too hilly and broken for cultivation. Nearly half the acreage of this land is barren of vegetation, but good management on the rest helps to improve and maintain growth of native plants. If the land is well managed, it can be productive of tall grasses, such as big bluestem and prairie sandreed. Other native plants include little bluestem, blue grama, needle-and-thread, and prairie-clover. Some yucca and fringed sagebrush are in places.

CAPABILITY UNIT VIIs-2, NONIRRIGATED

Arvada loam, 0 to 3 percent slopes, is the only soil in this unit. It is deep, has a clayey subsoil, and is generally underlain by old alluvial materials. Salts have accumulated in the upper part of the subsoil.

This soil absorbs water slowly to very slowly. Its available water capacity is medium to high, but the stored water is not readily available to most plants other than adapted grasses. Soil blowing is a moderate hazard, mostly on the bare spots, or slickspots, that characterize

this soil. Sheet and gully erosion are moderate to severe hazards because of the runoff from steeper adjacent slopes.

This soil is unsuitable for cultivation because of its salt and alkali content and its very slowly permeable subsoil. A few areas are or have been cultivated, but these should be reseeded to grass. Grass is difficult to establish if the natural cover is depleted.

Native vegetation is mainly alkali sacaton, western wheatgrass, saltgrass, and alkaligrass. Four-wing saltbush is an important browse plant.

CAPABILITY UNIT VIIs-5, NONIRRIGATED

This unit consists only of Gravelly land-Shale outcrop complex, a mapping unit that is gently sloping to very steep. Layers of gypsum and bentonitic materials are in places.

This complex absorbs water at a moderate to slow rate. It has moderate to low available water capacity, but large amounts of water that could be available for plants are lost through erosion. Runoff is medium to rapid, and the hazards of sheet and gully erosion are very severe unless this complex is well managed.

In most areas, machinery cannot be used for reseeding or range improvements as the soils are too gravelly, too shallow, or too steep and rough. Control of grazing helps to prevent deterioration of the plant cover and aids in erosion control.

Use and Management of the Soils for Range [3]

Rangeland, or land used primarily for producing native forage for livestock, makes up approximately 240,000 acres in Adams County. This land is more extensive in the eastern part of the county than it is along the irrigated Platte River Valley in the western part.

Adams County, a part of the Colorado Piedmont, extends from the foothills of the Rocky Mountains eastward for more than 60 miles into the heart of the Central High Plains. Vegetation and soils are more representative of the plains than they are of the foothills or mountains.

Except for a minor percentage on bottom land and in meadow, most of the rangeland is gently sloping to rolling and on semiarid uplands. Trees are entirely absent from this rangeland (fig. 14).

In the eastern part of the county, where individual ranches are large, livestock operations are large cattle and sheep ranches. Range livestock units that are closer to the irrigated and dryfarming areas are smaller.

Most ranches have breeding herds of cows and calves or bands of ewes and lambs. However, some landowners graze steers or have a combination of cows, calves, and steers.

Range sites and condition classes

Soils differ in their capacity to produce vegetation. The kinds and amounts of native forage plants in an area depend on the combined effect of the soil and climate. A range site is an area where climate and soil are sufficiently uniform to produce about the same kinds and amounts of vegetation.

The availability of soil moisture for plant use is the most significant factor that controls the vegetation on site. This is directly related to the climate, soil, slop and other soil features. Adams County is within a 13- to 17-inch annual precipitation zone. More than two-thirds of the precipitation falls between April 1 and September 30, and this is the main period for the growth of plants. The climate is characterized by large fluctuations in the total amount of rainfall from year to year. Moreover, some parts of the county receive a good rain from a storm, but a few miles away the soil is dry. Total rainfall in inches is deceptive in that a great percentage falls in a single high-intensity thunderstorm at a rate greatly exceeding the ability of the soil to absorb it. This results in loss of water through runoff, particularly from soils that do not have adequate plant cover. Substantial amounts of rainfall are in the form of showers so light that they scarcely dampen the soil; their benefits quickly vanish through evaporation.

The determination of range condition of a site is done by comparing the vegetation now on the site with the kind and amount of vegetation the site has a potential for producing. The condition classes recognized are excellent, good, fair, and poor. A range is in *excellent* condition if 76 to 100 percent of the vegetation is like the original plant community on the same site. It is in *good* condition if the percentage is 51 to 75; in *fair* condition if the percentage is 26 to 50; and in *poor* condition if it is 25 or less.

The most common reason for a range site to decline in condition is heavy use by livestock. Fire, long droughts, and other types of destruction can also lower the condition of a site.

As livestock graze they select the plants they like be. If these selected plants are grazed closely every season, they disappear from the stand. These kinds of plants are referred to as *decreasers*. Generally when a range site is in excellent condition, it will have an abundance of decreasers. *Increasers*, on the other hand, are those plants that, because of palatability, their form of growth, or their particular aggressiveness, spread when the decreasers are thinned. Many increasers are good forage plants, however, and they too become less abundant as range deteriorates toward a poor condition. The last plants to populate a site when it has lost its original vegetative cover are the *invaders*. These are usually weedy, brushy, thorny, or other types of plants that are generally of low forage value and that were absent in the original cover.

Descriptions of range sites

The following pages contain descriptions of the 12 range sites in Adams County. The range site for most nonirrigated mapping units is listed in the "Guide to Mapping Units."

Total annual yields are given for each of the range sites. This is expressed as the total annual growth in pounds per acre, on an air-dry basis, of all leaves, stems, twigs, and fruits of all plants of the site when the site is in excellent condition. The variation in production is given for yields expected in years of favorable and less favorable moisture. Yields were obtained from act' clippings and supplemented by field estimates.

[3] THOMAS K. EAMAN, range conservationist, Soil Conservation Service, helped to prepare this section.

***Figure 14.*—Cattle grazing on associated Blakeland and Truckton soils.**

Because the total annual yield consists of all growth all plants, an estimate of the part that provides forage for cattle is also given.

LOAMY PLAINS RANGE SITE

This range site is extensive in Adams County. The soils are loams to fine and very fine sandy loams. They are deep to moderately deep and have zones where lime has accumulated in the subsoil. The soils take in water moderately well and have good available water capacity.

Blue grama, the dominant grass on this site, survives well during periods of drought, which commonly occur in the county. After drought, when the soils are once again moist, blue grama quickly recovers and produces a quantity of good forage.

Western wheatgrass, the important decreaser, is scattered in the stand with blue grama. It decreases with heavy grazing, long droughts, or other disturbances, but blue grama tends to increase and form a tight sod (fig. 15). Also in the stand, though in much smaller amounts, are buffalograss, three-awn, sand dropseed, prickly pear, and snakeweed, all increasers, and four-wing saltbush, a decreaser. Sunflower, Russian-thistle, six-weeks fescue, and other annuals invade bare areas or places where the cover has been thinned in advanced stages of deterioration.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from as low as 500 pounds per acre in an unfavorable year to as high as 1,300 pounds in a favorable year. Nearly all of the total ual yield comes from plants that provide forage for attle.

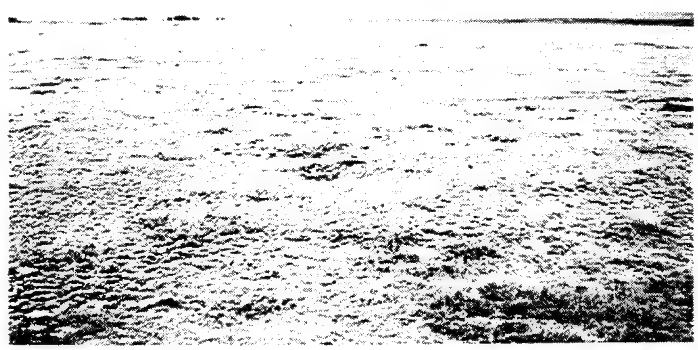

***Figure 15.*—Blue grama and taller western wheatgrass form sod on Weld soils in the Loamy Plains range site.**

LOAMY SLOPES RANGE SITE

This range site occupies only a small acreage in Adams County. It adjoins the Loamy Plains range site where the soils slope sharply away from the uplands into draws and bottoms. The soils are loamy in texture and strongly sloping. They are subject to excessive runoff and erosion. Deep-rooting grasses are best adapted to this range site. If a good cover of them is maintained, more water is conserved and less soil is lost than when the site has a sparse cover of short grass.

Side-oats grama, little bluestem, western wheatgrass, and needle-and-thread, and a few patches of prairie sandreed, are the important grasses, and all are decreasers. Blue grama, an increaser, grows in bunches throughout the stand. Three-awn, sand dropseed, and threadleaf

sedge are of minor importance. Snakeweed is the most common shrubby plant, but it is not abundant unless range condition is poor.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from as low as 400 pounds per acre in an unfavorable year to as high as 1,200 pounds in a favorable year. About 80 percent of the total annual yield comes from plants that provide forage for cattle.

CLAYEY PLAINS RANGE SITE

The slowly permeable, clayey soils of this range site are suitable only for the most drought-resistant plants. Blue grama, an increaser, is well suited to this site and makes up most of the stand. Western wheatgrass, a decreaser, makes most of its growth early in spring when soil moisture is available. The clayey soils, because of their good capacity for storing water, favor the growth of western wheatgrass. Buffalograss, three-awn, pricklypear, and rabbitbrush are all increasers on this range site.

If this range site deteriorates from excellent towards poor condition, it first becomes dominated by the increasers. Then, if the original cover is destroyed by heavy grazing, the site is invaded by annuals, including wheatgrass, Russian-thistle, sunflower, and kochia. Once the native cover is destroyed, the soils of this site become even less pervious because fine soil particles sift into pores and cracks in the soil more readily than they do if the soils have a cover to protect them from rain and wind.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 400 pounds per acre in an unfavorable year to as high as 950 pounds in a favorable year. About 80 percent of the total annual yield comes from plants that provide forage for cattle.

SANDY PLAINS RANGE SITE

The soils of this range site take in water at a good rate and are well suited to holding moisture at lower soil depths. Thus, forage production on this soil is more dependable from year to year than it is on sites having less sandy soils. Blue grama is an important increaser, but it is not so dominant that it excludes side-oats grama, needle-and-thread, little bluestem, and prairie sandreed, all decreaser grasses. Sand sagebrush and yucca grow as scattered increaser plants. Annual weeds are the principal invaders.

Areas of these soils that are bare or have sparse cover are subject to soil blowing.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 600 pounds per acre in an unfavorable year to as much as 1,800 pounds in a favorable year. About 90 percent of the total annual yield comes from plants that provide forage for cattle.

DEEP SAND RANGE SITE

The deep, sandy soils of this range site take in water rapidly. The depth to which water can move is restricted only by the amount of rainfall. The available water capacity is low, but the rapid drying of the surface layer helps to conserve soil moisture by reducing water losses through evaporation.

Deep-rooting plants having extensive roots make the most growth on this site. Two tall grasses—sand blu stem and prairie sandreed—are dominant (fig. 16). These, along with little bluestem, side-oats grama, switchgrass, and other decreasers, comprise most of the cover. Blue grama, sand dropseed, three-awn, and needle-and-thread increase as the range condition deteriorates. Sand sagebrush and yucca increase sharply as the stand of grasses is thinned by repeated close grazing. A range in poor condition is characterized by having a cover of weeds, scattered sagebrush, and unstable soils that are readily susceptible to soil blowing.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from about 1,500 pounds per acre in an unfavorable year to about 2,000 pounds in a favorable year. About 80 percent of the total annual yield comes from plants that provide forage for cattle.

SHALE BREAKS RANGE SITE

The soils of this range site are clayey and generally steep. The intake of water is slow in these soils. The production of forage is low and is limited to plants best adapted to grow under such conditions.

Western wheatgrass is dominant in the plant cover (fig. 17), but it decreases with repeated annual close grazing. Alkali sacaton, a decreaser, is a salt-tolerant bunchgrass that is scattered in the stand over the site. Four-wing saltbush and winterfat provide browse, and they too act as decreasers, as do side-oats grama and needlegrass. Blue grama produces much of the forage on the site and reacts to continued overuse by increasing.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from about 5[illegible] pounds per acre in an unfavorable year to about 1,0[illegible] pounds in a favorable year. About 75 percent of the total yield comes from plants that provide forage for cattle.

SANDSTONE BREAKS RANGE SITE

Stones and fragmented rocks in and on the soils of this site help to increase the amount of water, in a given volume of soil, that is available to plants. Consequently, this site has the potential for producing more forage by plants requiring more water than would a soil without stones in this semiarid climate.

Two tall grasses, big bluestem and prairie sandreed, are dominant on this site and decrease with heavy grazing. Other decreasers in the stand are little bluestem, side-oats grama, needle-and-thread, and prairie-clover.

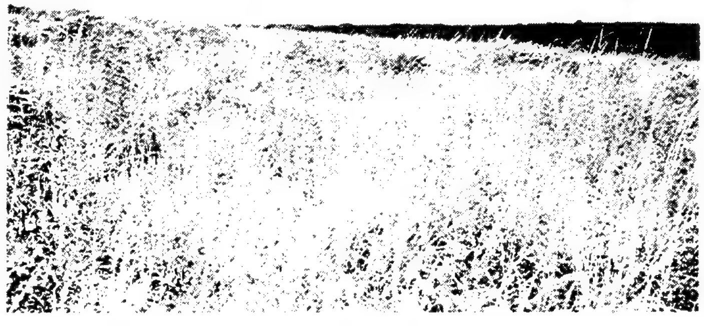

Figure 16.—**Tall sandyland grasses are dominant on Blakeland s in a Deep Sand range site in good to excellent condition.**

Figure 17.—Western wheatgrass protects the Shale Breaks range site from erosion and produces forage for grazing. Four-wing saltbush grows in scattered stands on Samsil soils.

Blue grama and threadleaf sedge increase in amount as the foregoing plants decrease. Yucca, fringed sagebrush, sand dropseed, junegrass and Indian ricegrass are other native plants.

When this site is in excellent condition, the total annual yield ranges from about 800 pounds per acre in an unfavorable year to about 1,700 pounds in a favorable year. About 80 percent of the total annual yield comes from plants that provide forage for cattle.

OVERFLOW RANGE SITE

The soils of this range site receive extra water from floods along draws and in swales. This results in a thick stand of grasses.

Bluestem, a decreaser, is the dominant grass. Other decreasers that make up a substantial part of the cover are switchgrass, slender wheatgrass, and side-oats grama. Western wheatgrass grows in an almost continuous stand in the understory and is an increaser.

Other plants that increase in amount when this site is subjected to repeated close grazing are blue grama, buffalograss, three-awn, and sand dropseed. If the condition of the range deteriorates, the site is invaded by rabbitbrush, pricklypear, Russian-thistle, kochia, and other plants that are absent on a site in excellent condition.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from about 1,500 pounds per acre in an unfavorable year in which there is little run-in water to about 3,000 pounds in a favorable year. Nearly all of the total annual yield comes from plants that provide forage for cattle.

ALKALINE PLAINS RANGE SITE

The soils of this range site are generally fine textured and strongly saline-alkali, especially in the subsoil. Gypsum in the soils helps to reduce the effects of the alkali.

Alkali sacaton, one of the grasses most tolerant of excess salts and alkali, is the dominant plant. It tends to increase in abundance as blue grama and western wheatgrass decrease. Also in the stand is a scattering of four-wing saltbush, a decreaser. Rabbitbrush, pricklypear, and ring muhly increase with heavy grazing. If the site is in poor condition a thin stand of annual weeds is characteristic.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges between 500 pounds per acre to 1,000 pounds in both favorable and unfavorable years. About 90 percent of the total annual yield comes from plants that provide forage for cattle.

SALT FLAT RANGE SITE

The soils of this bottom-land site are limited in the kinds and amounts of vegetation that can be grown because they contain excess salts and generally are slowly permeable clay. A layer beneath the surface is particularly retarding to the downward movement of water. The salinity of the soils is caused by the material in which the soils formed and also by the entry of salty water that spreads over the site from uplands or from overflowing streams. There is no water table beneficial to plant growth.

Alkali sacaton, a grass that is suited to saline soils, makes up most of the cover and forage on this site. If the condition of the site declines, alkali sacaton decreases and is replaced by saltgrass, greasewood, and other increasers. Also in the stand are western wheatgrass, alkaligrass, and four-wing saltbush, a principal browse plant. Overgrazing and other similar misuse of this site results in bare soil (fig. 18), increased amounts of rabbitbrush and weeds, and a sharp reduction in alkali sacaton.

When this site is in excellent condition, the total annual yield of air-dry herbage is as much as 1,500 pounds per acre if moisture conditions are favorable, but it is as low as half this amount in unfavorable years. About 90 percent of the total annual yield comes from plants that provide forage for cattle.

WET MEADOW RANGE SITE

The soils of this range site have water in abundance and within reach of plant roots most of the time. Intermingled with areas of the site are places that are permanently wet and covered with cattails and other water-tolerant plants. The soils vary in texture, are deep, and are nearly level.

The meadow vegetation of this site includes a number of tall prairie grasses that tend to decrease under heavy grazing. Chief among these are switchgrass, prairie cordgrass, big bluestem, and indiangrass. Sedges, rushes, and wheatgrass increase as the taller grasses decrease. The forage of this site is of high quality and is cut for hay in some places.

The total annual yield of air-dry herbage is as much as 4,000 pounds per acre or more. Because the site does not depend on annual rainfall, the production on a site in excellent condition varies little. About 80 percent of the total annual yield comes from plants that provide forage for cattle.

GRAVEL BREAKS RANGE SITE

The soils of this range site contain gravel that permits rapid infiltration of water. Because of the gravel, however, moisture holding properties are fair to low.

Figure 18.—**Slickspots and a hummocky surface result from overuse of a Salt Flat range site on Arvada soils.**

The soils dry out rapidly, and, for this reason, plants having a root system that reaches into a large area of soil are best adapted. The soils on this site are gently sloping to steep.

Side-oats grama, little bluestem, and needle-and-thread are the dominant grasses on this site, but prairie-clover is common. All of these plants are decreasers. Blue grama, hairy grama, and Indian ricegrass are common increasers. Other increasers of less importance are hairy goldaster, dotted gayfeather, buckwheat, yucca, snakeweed, and sageworts.

When this site is in excellent condition, the total annual yield of air-dry herbage ranges from 750 pounds per acre to 1,200 pounds both in unfavorable and favorable years. About 90 percent of the total annual yield comes from plants that provide forage for cattle.

Use and Management of the Soils for Trees and Shrubs [4]

The native cover in most of the county is grass. The dry, cold winters are not good for the growth of trees, and wooded areas are scarce.

Small stands of cottonwood and willow trees are in areas of Sandy alluvial land, Loamy alluvial land, and Wet alluvial land along most of the major drainageways. Such wooded areas are highly valued as protection for livestock during severe blizzards in winter.

If windbreaks and shelterbelts are grown, they return substantial benefits to landowners. They protect homes against cold, wintry winds and reduce the cost of heating. They protect gardens, provide shade in summer, and enhance the beauty of the home and its surroundings. They control the drifting of snow in winter and protect livestock. They provide food and cover for wildlife and a habitat for birds.

[4] W. S. SWENSON, woodland conservationist, Soil Conservation Service, assisted in preparing this section.

Care is needed in selecting locations for windbreak plantings with respect to buildings, roads, and farm improvements. Care is also needed in selecting trees that are adapted to the climate and suited to the soils at the planting site. Tree and shrub plantings can be of great va in acting as a buffer to noise from busy highways and control drifting soil or dust by collecting it in the outside rows.

Evergreens are the most desirable trees for windbreaks because they are long lived and resist damage by snow, wind, insects, and disease. Two- or three-year-old seedlings that have been grown in tar-paper pots are the most successful. Evergreens grow much more slowly than broadleaf trees or shrubs for the first few years. For this reason, they should be planted in two or more single rows, and separate rows of the faster growing but shorter lived broadleaf trees should be planted to provide protection while the evergreens are growing.

Assistance in planning windbreaks is available through the local office of the Soil Conservation Service, from the Agricultural Extension Service, and from the Colorado State Forest Service at Fort Collins.

The kinds of trees and shrubs that are adapted to the climate of this survey area are limited. Cultivation is important if trees are to survive and grow. Cultivation should be timely so that the planting is kept free of weeds and grass that compete with tree roots for the limited supply of moisture. Cultivation also reduces the hazard of fire, which would probably kill the trees.

The young trees and shrubs need protection from livestock, and fencing is important if animals are pastured nearby. Rabbits, mice, deer, and antelope damage the plantings during the first few years, and a suitable repellent should be applied each fall. The trees and shrubs

should be examined occasionally for disease and harmful insects.

Pruning should be confined to removing dead limbs and branches. Pruning does not stimulate growth in height: it only decreases the density of the planting and results in poorer protection against wind and drifting snow.

Watering newly planted trees and shrubs provides needed moisture and helps to set the soil more firmly around the roots. During the first year or two, it is most important that the soil does not become too dry, and it is frequently necessary to water the plants to obtain maximum survival.

Tree planting suitability groups

The soils of this survey area have been placed in five tree planting suitability groups. The group in which each soil has been placed is shown in the "Guide to Mapping Units" at the end of this survey. The soils in each group are suitable for similar species, and the trees and shrubs have similar response to good management.

Table 4 lists the species of trees and shrubs that are suitable for the soils of group 1, 2, and 3. The soils of group 4 are generally unsuited to trees and shrubs and are not rated in this table. Soils of group 5 are not rated in table 4, but they have some native tree growth on them, principally cottonwoods and willows. These soils are seldom planted with other species. The table also gives the expected height that trees and shrubs of each species will reach at about 20 years of age and the survival rate that can reasonably be expected after 1 or 2 years if replanting is required. The rating in the "Vigor" column refers to the density of the foilage, eedom from disease or damage by insects, and the general appearance of the tree. The ratings in this table are based on general observation of well-tended plantings.

TREE PLANTING SUITABILITY GROUP 1

This group consists of moderately deep to deep, well-drained loams and clay loams that have moderate to high available water capacity. These soils absorb water at a moderate rate. They are free of injurious salts.

Trees that are adapted to the climate grow well on these soils, but they are difficult to establish in places. Good seedbed preparation, control of weeds, and supplemental watering help to establish the young plants. Where the slope is more than 5 percent, the trees should be planted on the contour or behind terraces. The rows should be at least 20 feet apart, so that each tree receives adequate moisture and has sufficient room for development, and so that cultivation between the rows is possible.

Wind, soil blowing, and drought are the chief hazards to newly planted trees. To overcome these hazards, the soils should be in summer fallow for a season before planting. Runoff should be diverted from adjacent areas onto the planting site. Cover crops can be grown between rows of young trees the first 2 or 3 years so that plant cover helps to reduce the temperature of the uppermost few inches of soil, checks soil blowing, and lessens the hazard of water erosion by slowing runoff.

TREE PLANTING SUITABILITY GROUP 2

This group consists of deep, well-drained to somewhat excessively drained sandy loams and loamy sands that have moderate to low available water capacity. These soils absorb water at a moderate rate. They do not contain harmful salts.

Evergreens are better suited to these soils than broadleaf trees because they adapt better to the dry climate. Controlling weeds lessens the competition for moisture. Snow fences along the northern and western sides of the planting area help to protect new plantings from drifting snow in winter and also channel additional moisture into the planting area. Where the slope is more than 5 percent, the trees should be planted on the contour. The rows should be at least 20 feet apart, so that each tree receives adequate moisture and has sufficient room for development, and so that cultivation between the rows is possible.

Soil blowing, a serious hazard on these soils, generally can be controlled by leaving strips of vegetation or stubble between the rows of trees.

TREE PLANTING SUITABILITY GROUP 3

This group consists of shallow or sandy soils that have low avaliable water capacity and of clayey soils that lack good aeration for trees and shrub roots. Included in the group are complexes of soils, some of which are suited to trees and others that are not. On the soils of these complexes, careful onsite investigation is needed before plantings are made.

TABLE 4.—*Ratings of soils for tree and shrub plantings and species suitability*

Suitable species	Soils of group 1			Soils of group 2			Soils of group 3		
	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor	Height at 20 years	Survival rate	Vigor
	Feet	*Percent*		*Feet*	*Percent*		*Feet*	*Percent*	
Ponderosa pine	18–20	80	Good	20–22	90	Good	12–15	75	Fair.
Rocky Mountain juniper	8–12	80	Good	10–14	90	Good	8–10	80	Good.
Siberian elm	20–25	90	Fair	25–30	95	Good	15–20	80	Fair.
Russian-olive	16–20	85	Fair	16–20	90	Good	12–18	80	Good.
Common lilac	6–8	90	Good	6–8	90	Good	5–7	85	Fair.
Squawbush (quailbush)	5–7	90	Good	5–7	90	Good	4–6	85	Good.

Trees can grow on the soils in this group, but their expected survival, growth, and vigor are not so good as on soils in groups 1 and 2. Drought, soil blowing, and water erosion are the chief hazards. Only the hardiest adapted species should be planted. If trees are planted on these soils, practices should be used to improve the moisture supply, such as diversion ditches that lead into the planting area, snow fencing, and planting on the contour or behind terraces. In irrigated areas special care is commonly needed in applying water.

TREE PLANTING SUITABILITY GROUP 4

This group consists of soils that are generally unfavorable or unsuitable for trees because of one or more limitations. These limitations are salinity, alkalinity, slope, excessive wetness, poor aeration, cobblestones, gravel, shallowness, low available moisture capacity, and unfavorable texture such as dune sand or very heavy clay. Trees are not commonly desired or planted on soils of this group.

Some small areas of soils in this group are satisfactory for trees in places. Other soils can be improved by providing better drainage, by using salt- or alkali-reducing practices, and by applying similar measures.

Onsite investigation is needed on the soils of this group before trees are planted. Assistance can be obtained by contacting the local office of the Soil Conservation Service.

TREE PLANTING SUITABILITY GROUP 5

This group consists of loamy soils on bottom lands that are subject to flooding. The water table is at a depth within the reach of tree roots.

Trees, particularly cottonwood and willow, grow rapidly on these soils, but they are seldom planted. Most of the trees have grown from seed washed or blown along the stream channels. Russian-olive in some areas has escaped from adjacent plantings and is becoming established on some soils in this group.

Only species of trees that can tolerate a considerable amount of moisture are well suited. Although some care, such as cultivation and weed control, is required for the first 2 or 3 years, the trees then develop without further care and grow as do trees that are irrigated. Growth and survival rates are extremely variable.

Use of the Soils for Wildlife [5]

Wildlife requires habitats where it can feed, rest, hide, sleep, breed, and rear young. Specific needs for such areas vary for different kinds of wildlife. However, these areas are necessary for survival. The degree to which the needs are met largely determines the kinds and numbers of animals that are present in an area.

Soil, and the uses made of it, are basic keys to wildlife abundance. This is true because wildlife is a product of the soils on which it lives, just as are livestock, grain, or sugar beets. Basically, the soils must satisfy the needs of an animal or it disappears from the area.

Soil, because it is so vital to the welfare of wildlife, is used here to rate the soil associations on their suitability to provide food, cover, and water for wildlife (see the section "General Soil Map"). This rating, based on soil associations, is broad, and anyone interested in developing wildlife habitat is urged to contact the lo office of the Soil Conservation Service for assistance.

Urbanization, and its resulting changes in land use, have altered the species and numbers of wildlife in the county, especially in the western part. Anyone considering wildlife developments should give due consideration to changing land use early in the planning stage.

Table 5 contains ratings of suitability of the soil associations for the more important kinds of wildlife in Adams County.

The potential of recreation enterprises is also often closely related to the soil. A knowledge of the soils on sites proposed for development is vital because soil limitations exist in places that prevent certain activities or require extra measures to correct. Soil limitations include such characteristics as wetness, slope, soil depth, high water table, stoniness, and many others that can affect use of lands for recreational developments. The economic aspects, health, and safety are concerns in soil limitations.

[5] EDDIE W. MUSTARD, biologist, Soil Conservation Service, helped to prepare this section.

Engineering Uses of the Soils [6]

This section provides information of special interest to engineers, contractors, farmers, and others who use soil as structural material or as foundation material upon which structures are built. In this section are those properties of the soils that affect construction and maintenance of roads and airports, pipelines, building foundations, water storage facilities, erosion control structures, drainage systems, and sewage disposal s tems. Among the soil properties and qualities most i portant in engineering are permeability, shear strength, density, shrink-swell potential, available water capacity, grain-size distribution, plasticity, and reaction.

Information concerning these and related soil properties are furnished in tables 6 and 7. The estimates and interpretations of soil properties in these tables can be used in—

1. Planning and designing of drainage systems, farm ponds, irrigation systems, terraces, and other structures for controlling water and conserving soil.
2. Selecting potential locations for highways, airports, pipelines, and underground cables.
3. Locating probable sources of sand or gravel suitable for use as construction material.
4. Selecting potential industrial, commercial, residential, and recreational sites.

The engineering interpretations here reported do not eliminate the need for sampling and testing at the site of specific engineering works involving heavy loads and where the excavations are deeper than the depths of layers here reported. Even in these situations, however, the soil map is useful in planning more detailed field investigations and for indicating the kinds of problems that can be expected.

[6] R. I. BLEWITT, assistant State conservation engineer, Soil C servation Service, assisted in preparing this section.

TABLE 5.—*Suitability of soil associations for wildlife habitat*

[Suitability of 1 denotes well suited; 2, moderately well suited; 3, poorly suited; and 4, not applicable or need unknown]

Soil association	Kinds of wildlife [1]	Suitability for— Food	Cover	Water: Natural	Water: Developed
1. Weld-Adena-Colby.	Open land	1	4	4	4
	Upland	2	2	3	2
	Fish	4	4	4	3
2. Samsil-Shingle.	Open land	3	4	4	3
	Upland	3	3	3	3
	Fish	4	4	4	3
3. Ascalon-Vona-Truckton.	Open land	1	4	4	4
	Upland	1	1	3	2
	Fish	4	4	4	3
4. Nunn-Satanta.	Open land	2	4	4	4
	Upland	1	1	1	3
	Wetland	1	1	1	2
	Fish	4	4	3	3
5. Alluvial land.	Upland	1	2	1	3
	Woodland	2	2	1	3
	Wetland	1	1	1	3
	Fish	4	4	3	3
6. Terry-Renohill-Tassel.	Open land	1	4	4	4
	Upland	1	1	3	3
	Woodland	3	3	3	3
7 Blakeland-Valent-Terry.	Open land	1	4	4	4
	Upland	1	1	3	3
8. Arvada-Heldt-Nunn.	Open land	3	4	4	4
	Upland	2	2	3	2
	Wetland	2	2	2	2
	Fish	4	4	3	3
9. Platner-Ulm-Renohill.	Open land	1	4	4	4
	Upland	1	1	3	2
	Wetland	1	1	3	2
	Fish	4	4	3	2

[1] Among the kinds of wildlife are antelope and jackrabbit on open land; pheasant, cottontail rabbit, mourning dove, and bobwhite on upland; mule deer in woodland; and ducks and geese on wetland.

Some terms used by soil scientists may be unfamiliar to engineers, and some words have different meanings in soil science than they have in engineering. These and other terms are defined in the Glossary at the back of the survey.

Engineering classification systems

The two systems most commonly used in classifying samples of soil horizons for engineering are the AASHO system adopted by the American Association of State Highway Officials, and the Unified system used by the Soil Conservation Service, the Department of Defense, and others.

The AASHO system is used to classify soils according to those properties that affect use in highway construction *(1)*. In this system, soils are placed in seven basic groups ranging from A-1 through A-7 on the basis of grain-size distribution, liquid limit, and plasticity index. In group A-1 are gravelly soils of high bearing strength, or the best soils for road fill, and at the other extreme, in group A-7, are clay soils that have low strength when wet. The best soils for road fill are therefore classified as A-1, the next best as A-2, and the poorest as A-7. If soil material is near a classification boundary, it is given a symbol showing both classes; for example, A-2 or A-4. The estimated classification for all soils mapped in the survey area is given in table 6.

In the Unified system soils are classified according to particle size distribution, plasticity, and liquid limit *(7)*. Soils are grouped in 15 classes. There are eight classes of coarse-grained soils, identified as GW, GP, GM, GC, SW, SP, SM, and SC; six classes of fine-grained soils, identified as ML, CL, OL, MH, CH, and OH; and one class of highly organic soils, identified as Pt. Soils on the borderline between two classes are designated by symbols for both classes; for example, CH or MH.

TABLE 6.—*Estimated properties of*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The soil for referring to the other series that appear in the first colu

Soil series and map symbols	Depth from surface	Classification: USDA texture	Classification: Unified	Classification: AASHO
	Inches			
*Adena: AaB, AaC, AcC, AcD. For properties of Colby soils in AcC and AcD, refer to Colby series.	0–11	Loam, clay loam, silty clay loam.	ML or CL	A–4 or A–6
	11–60	Silty clay loam, silt loam	ML or CL	A–4 or A–6
Arvada: AdB	0–4	Loam, sandy loam	SM or ML	A–4 or A–2
	4–28	Clay, sandy clay	CL or CH	A–7
	28–60	Sandy loam	SM	A–2 or A–4
*Ascalon: ArB, ArC, AsB, AsC, AsD, At, AvC. For properties of Platner soils in At and Vona soils in AvC, refer to their respective series.	0–21	Loamy sand, sandy loam, and sandy clay loam.	SM or SC	A–2 or A–4
	21–60	Sandy loam	SM	A–2 or A–4
*Blakeland: BoD, Bt. For properties of Truckton soils in Bt, refer to Truckton series.	0–60	Loamy sand and sand	SP–SM or SM	A–2 or A–3
Colby: CbE	0–60	Loam and fine sandy loam	ML	A–4
Dacono: DaA, DaB	0–9	Loam	ML	A–4
	9–17	Clay	CH	A–7
	17–26	Sandy clay loam	SC	A–4
	26–60	Very coarse loamy sand, sand, and gravel.	SP or SM, SP–SM, or GP–GM	A–1
Deertrail. Mapped only in a complex with Weld soils.	0–9	Very fine sandy loam and loam	ML	A–4
	9–21	Clay	CH	A–7
	21–60	Silty clay loam and loam	CL or ML	A–4 or A–6
Gravelly land-Shale outcrop complex: Gr. Properties too variable to be estimated.				
Gullied land: Gu. Properties too variable to be estimated.				
Heldt: HlB, HlD	0–32	Clay	CH	A–7
	32–60	Silty clay loam, sandy clay loam.	CL	A–6
Loamy alluvial land:				
Lu	0–60	Loam, silt loam, and clay loam	ML or CL	A–4 or A–6
Lv	0–20	Stratified loam	ML	A–4
	20–60	Sand and gravel	SP or GP	A–1
Lw	0–36	Loam, clay, and stratified loam	ML or CL	A–4 or A–6
	36	Gravel	GP	A–1
Nunn:				
NlA, NlB	0–9	Loam and clay loam	ML	A–4 or A–6
	9–23	Clay	CH	A–7
	23–60	Loam and silt loam	CL or ML	A–4
NuA, NuB	0–9	Clay loam	CL	A–6
	9–23	Clay	CH	A–7
	23–60	Loam and silt loam	CL or ML	A–6 or A–4
Platner: PlB, PlC	0–9	Loam	ML	A–4
	9–18	Clay	CH	A–7
	18–60	Clay loam, loam, and sandy loam.	SM, ML, or CL	A–6 or A–4
Renohill: ReB, ReD	0–9	Loam and clay loam	ML or CL	A–6
	9–28	Clay and clay loam	CH	A–7
	28	Shale and sandstone.		

soils significant to engineering

h mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions
. ne sign > means more than, and the sign < means less than]

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
				Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos./cm. at 25° C.*	
100	100	85–95	70–85	0.06–0.20	0.19–0.21	6.6–7.8	0–4	Moderate.
100	100	90–100	70–90	0.63–2.0	0.19–0.21	7.9–9.0	0–4	Low to moderate.
100	100	60–90	30–60	0.63–6.3	0.11–0.18	7.9–8.4	0–8	Low.
100	100	90–100	80–90	<0.06	0.04–0.06	7.9–10.0	8–15	High.
100	95–100	60–70	30–40	2.0–6.3	0.04–0.06	7.9–9.0	4–15	Low.
100	95–100	60–80	30–50	0.63–2.0	0.13–0.15	6.6–7.8	0–4	Low to moderate.
100	95–100	60–70	30–40	2.0–6.3	0.11–0.13	7.9–9.0	0–4	Low.
100	100	50–75	5–15	6.3–20.0	0.06–0.08	6.1–7.3	0–2	Low.
100	100	80–95	50–80	0.63–2.0	0.16–0.18	7.9–8.4	0–4	Low to moderate.
90–100	85–100	80–90	60–70	0.63–2.0	0.16–0.18	6.6–7.3	0–1	Low.
90–100	85–100	80–100	70–80	0.06–0.20	0.14–0.16	7.4–7.8	0–1	High.
90–100	85–100	80–90	35–50	0.63–2.0	0.14–0.16	7.9–8.4	0–2	Moderate.
50–65	25–35	15–25	0–15	>20.0	0.03–0.05	7.9–8.4	0–2	Low.
100	100	85–95	60–70	0.63–2.0	0.15–0.17	6.6–7.8	0–4	Low.
100	100	85–95	70–80	0.06–0.20	0.04–0.06	7.9–10.0	0–8	High.
100	100	90–100	75–85	0.63–2.0	0.04–0.06	7.9–10.0	4–8	Low to moderate.
100	100	95–100	80–95	0.06–0.20	0.14–0.16	7.9–8.4	0–2	High.
100	100	90–100	70–90	0.20–0.63	0.16–0.18	7.9–8.4	0–2	Moderate.
100	100	85–100	60–80	0.20–2.0	0.16–0.20	---------------	4–8	Low to moderate.
100	95–100	85–95	50–80	0.63–2.0	0.16–0.18	---------------	0–8	Low.
30–40	25–35	15–25	0–5	>20.0	0.03–0.05	---------------	0–2	Low.
100	100	85–95	50–80	0.20–2.0	0.16–0.20	---------------	0–8	Low to moderate.
30–40	25–35	15–25	0–5	>20.0	0.03–0.05	---------------	0–2	Low.
100	90–100	80–90	60–80	0.63–2.0	0.16–0.18	6.6–7.3	0–2	Moderate.
100	100	90–100	75–85	0.2–0.63	0.14–0.16	7.4–7.8	0–2	High.
100	90–100	80–90	60–80	0.63–0.20	0.18–0.20	7.9–8.4	0–4	Moderate.
100	90–100	80–90	60–80	0.20–0.63	0.19–0.21	6.6–7.3	0–2	Moderate.
100	90–100	80–90	75–85	0.06–0.20	0.14–0.16	7.4–7.8	0–2	High.
100	90–100	80–90	50–70	0.20–2.0	0.18–0.20	7.9–8.4	0–4	Moderate.
100	100	85–95	60–70	0.63–2.0	0.16–0.18	6.6–7.3	0–2	Moderate.
100	100	90–100	75–85	0.06–0.20	0.14–0.16	6.6–7.3	0–4	High.
100	90–100	75–85	40–75	0.63–2.0	0.16–0.18	7.9–8.0	0–4	Low to moderate.
100	100	85–95	70–80	0.2–0.63	0.18–0.20	7.4–8.4	0–2	Moderate.
100	100	90–100	70–95	0.06–0.20	0.15–0.17	7.9–9.0	0–2	High.

TABLE 6.—*Estimated properties of*

Soil series and map symbols	Depth from surface	Classification: USDA texture	Unified	AASHO
	Inches			
Rough broken land: Ro. Properties too variable to be estimated.				
*Samsil: SaE, ShF. For properties of Shingle soils in ShF, refer to Shingle series.	0–14	Silty clay	CL or CH	A–7
	14	Shale.		
Sandy alluvial land: Sm. Properties too variable to be estimated.				
Satanta: SnA, SnB	0–48	Loam, clay loam	CL or ML	A–6
	48–60	Fine sandy loam and loamy sand.	SM	A–2 or A–4
*Shingle: SrE. For properties of Renohill soils in this unit, refer to Renohill series.	0–12	Loam	ML	A–4
	12	Interbedded sandstone and shale.		
Stoneham: StB, StD	0–13	Loam, sandy clay loam	SC or CL	A–4 or A–6
	13–60	Gravelly loam, gravelly sandy loam.	SM	A–4 or A–2
Tassel. Mapped only in complexes with Terry, Ulm, and Vona soils.	0–18	Fine sandy loam	ML or SM	A–4
	18	Sandstone.		
Terrace escarpments: Tc. Properties too variable to be estimated.				
*Terry: TeB, TeD, TrE, TsE. For properties of Tassel soils in TrE and TsE, Ulm soils in TrE, and Vona soils in TsE, refer to their respective series.	0–39	Loamy fine sand and fine sandy loam.	ML and SM	A–4
	39	Sandstone.		
Truckton: TtB, TtD, TuB, TuC, TuD	0–21	Loamy sand and sandy loam	SM	A–2 or A–4
	21–60	Loamy sand and sand	SM or SM-SP	A–2 or A–3
Ulm: UlB, UlC, UlD	0–30	Loam and clay	CL or CH	A–6 or A–7
	30–48	Clay loam	CL	A–6
	48	Shale and sandstone.		
Valent: VaD	0–60	Loamy sand and loamy fine sand.	SM or SM-SP	A–2 or A–3
*Vona: VnB, VnD, VoA, VoB, VoC, VsD. For properties of Ascalon soils in VsD, refer to Ascalon series.	0–40	Loamy sand and sandy loam	SM	A–2 or A–4
	40–60	Loamy sand	SM	A–2
*Weld: WmB, WrB. For properties of Deertrail soils in WrB, refer to Deertrail series.	0–21	Loam and clay	ML and MH	A–4 and A–7
	21–68	Loam, fine sandy loam, silt loam, and very fine sandy loam.	CL or ML	A–4 or A–6
Wet alluvial land: Wt. Properties too variable to be estimated.				
*Wiley: WuE. For properties of Adena and Renohill soils in this unit, refer to their respective series.	0–24	Loam and clay loam	ML or CL	A–4 or A–6
	24–60	Very fine sandy loam	ML	A–4

soils significant to engineering—Continued

Percentage passing sieve— No. 4 (4.7 mm.)	No. 10 (2.0 mm.)	No. 40 (0.42 mm.)	No. 200 (0.074 mm.)	Permeability	Available water capacity	Reaction	Salinity	Shrink-swell potential
				Inches per hour	*Inches per inch of soil*	*pH*	*Mmhos./cm. at 25° C.*	
100	100	90–100	80–90	0. 06–0. 20	0. 14–0. 16	7. 9–9. 0	0–4	High.
100	90–100	85–90	60–80	0. 63–2. 0	0. 18–0. 20	7. 4–8. 4	0–2	Moderate.
100	100	50–80	20–50	2. 0–20. 0	0. 11–0. 13	7. 9–8. 4	0–2	Low.
100	90–100	80–90	50–80	0. 63–2. 0	0. 16–0. 18	7. 9–8. 4	0–4	Moderate.
100	85–100	70–80	40–60	0. 63–2. 0	0. 15–0. 17	7. 4–7. 8	0–2	Moderate.
100	65–75	40–50	20–40	2. 00–6. 3	0. 08–0. 10	7. 9–8. 4	0–4	Low.
100	100	70–85	40–55	2. 0–6. 3	0. 13–0. 15	7. 4–8. 4	0–2	Low.
100	100	70–85	35–55	2. 0–6. 3	0. 10–0. 12	7. 4–8. 4	0–2	Low.
100	100	50–75	15–40	2. 0–6. 3	0. 10–0. 12	6. 6–7. 3	0–2	Low.
100	100	50–70	5–15	6. 3–20. 0	0. 05–0. 07	6. 6–7. 8	0–2	Low.
100	100	85–95	70–95	0. 06–0. 20	0. 15–0. 17	6. 6–7. 8	0–4	High.
95–100	85–95	80–85	60–80	0. 06–0. 20	0. 19–0. 21	7. 4–8. 4	0–4	Moderate.
100	100	50–75	5–15	>20. 0	0. 07–0. 09	6. 6–7. 3	0–2	Low.
100	100	50–75	20–40	6. 3–20. 0	0. 10–0. 12	6. 6–8. 4	0–2	Low.
100	100	50–75	15–30	>20. 0	0. 07–0. 09	7. 9–8. 4	0–2	Low.
100	100	90–100	60–90	0. 06–0. 20	0. 15–0. 17	6. 6–7. 8	0–2	High.
100	100	80–100	50–80	0. 63–2. 0	0. 16–0. 18	7. 4–8. 4	0–4	Low.
100	100	85–100	60–80	0. 2–0. 63	0. 18–0. 20	7. 4–8. 4.	0–2	Low to moderate.
100	100	85–95	50–65	0. 63–2. 0	0. 15–0. 17	7. 9–8. 4	0–4	Low.

TABLE 7.—*Engineering*

[An asterisk in the first column indicates that at least one mapping unit in the series is made up of two or more kinds of soil. The soils referring to the other ser

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
*Adena: AaB, AaC, AcC, AcD For interpretations of Colby soils in AcC and AcD, refer to Colby series.	Generally fair but good in upper 4 inches.	Unsuited: more than 50 percent fines; no gravel.	Fair to poor: A–4 and A–6.	Unstable silty material below depth of 10 inches.
Arvada: AdB	Poor: saline-alkali clay at a depth of 4 inches.	Unsuited: more than 50 percent fines; no gravel.	Poor: A–7	Flooding hazard; plastic soils.
*Ascalon: ArB, ArC, AsB, AsC, AsD, At, AvC. For interpretations of Platner soils in At and Vona soils in AvC, refer to their respective series.	Fair to poor: sandy loam and loamy sand.	Poor: poorly graded; 30 to 50 percent fines; less than 25 percent gravel.	Good to fair: A–2 and A–4.	Severe hazard of soil blowing in borrow areas.
*Blakeland: BoD, Bt For interpretations of Truckton soils in Bt, refer to Truckton series.	Poor: loamy sand	Good to fair for sand: 5 to 15 percent fines; no gravel.	Good: A–2 or A–3.	Severe hazard of soil blowing in borrow areas.
Colby: CbE	Fair: very calcareous.	Unsuited: more than 50 percent fines; no gravel.	Fair: A–4	Silty material
Dacono: DaA, DaB	Generally fair but good in upper 9 inches.	Good for sand below a depth of 35 inches; poorly graded. Good for gravel below a depth of 35 inches.	Fair to poor to a depth of 35 inches. Good below a depth of 35 inches; A–1, A–4, and A–7.	Clay and sandy clay loam to a depth of 35 inches; sand and gravel below a depth of 35 inches.
Deertrail Mapped only in a complex with Weld soils.	Poor: saline-alkali soils; clayey subsoil.	Unsuited: more than 50 percent fines; no gravel.	Fair to poor: A–4 to A–7.	Saline-alkali material.
Gravelly land-Shale outcrop complex: Gr	Poor: gravel and shale.	Spotty source of good gravel; unsuitable for sand.	Fair to poor: shale and gravel spots.	Steep slopes; gravel and shale.
Gullied land: Gu	Poor: eroded soils susceptible to erosion.	Unsuited: more than 50 percent fines; no gravel.	Poor: gullied land.	Steep slopes; erodible soils.

See footnote at end of table.

...terpretations of soils

...ch mapping units may have different properties and limitations, and for this reason it is necessary to follow carefully the instructions for that appear in the first column]

Soil features affecting—Continued				Soil limitations for—	
Farm ponds		Agricultural drainage	Irrigation	Foundations for low buildings	Septic tank filter field[1]
Reservoir area	Embankment				
Moderate permeability below a depth of 10 inches; slopes of 0 to 9 percent.	Medium to low shear strength; medium piping hazard.	Slow permeability in subsoil; flat to gently rolling; unstable ditchbanks; silty soils.	Moderate to slow intake rate.	Slight to moderate: low to moderate shrink-swell potential.	Slight to moderate: moderate permeability below a depth of 10 inches.
Very slow permeability in subsoil; moderately rapid permeability in substratum; slopes of 0 to 3 percent.	Low to medium shear strength; medium piping hazard.	Very slow permeability.	Very slow permeability; strongly alkaline soils.	Severe: high shrink-swell potential.	Severe: very slow permeability.
Moderate to moderately rapid permeability; slopes of 1 to 9 percent.	Medium shear strength; medium piping hazard.	No adverse features.	Moderate to high available water capacity; 1 to 9 percent slopes.	Slight to moderate: low to moderate shrink-swell potential.	Slight where slopes are 1 to 5 percent; moderate where slopes are 5 to 9 percent.
Rapid permeability; slopes of 3 to 9 percent.	Medium shear strength; medium piping hazard.	Not needed	Low available water capacity; rolling to moderately sloping.	Slight	Slight where slopes are 3 to 5 percent; moderate where slopes are 5 to 9 percent.
Moderate permeability; slopes of 5 to 20 percent.	Low to medium shear strength; high piping hazard.	Moderately steep to rolling unstable ditchbanks; silty soils.	Moderately steep	Moderate to severe: slopes of 5 to 20 percent.	Moderate where slopes are 3 to 10 percent; moderate permeability; severe where slopes are 10 to 20 percent.
Slow permeability; very rapid permeability below a depth of 3 feet; slopes of 0 to 3 percent.	Low to medium shear strength to a depth of 26 inches; high shear strength below a depth of 26 inches.	Sand and gravel at a depth of 20 to 40 inches; good outlets; slow permeability in subsoil.	Moderate available water capacity.	Moderate to severe: moderate to high shrink-swell potential.	Slight: sand and gravel at a depth of 20 to 40 inches; possible pollution of ground water.
Slow permeability; slopes of 0 to 1 percent.	Low to medium shear strength; medium piping hazard below a depth of 20 inches.	Slow permeability; poor outlets.	Slow intake rate; very strong alkalinity in subsoil and substratum.	Severe: high shrink-swell potential.	Severe: slow permeability.
Not applicable	Not applicable	Not applicable	Not applicable	Severe: gravel and shale.	Severe: steep slopes; shallow to shale.
Not applicable	Not applicable	Not applicable	Not applicable	Severe: gullied	Severe: steep slopes; gullied.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting
	Topsoil	Sand and gravel	Road fill	Highway location
Heldt: HlB, HlD	Poor: high clay content; moderately alkaline.	Unsuited: more than 50 percent fines; no gravel.	Poor: A–6 and A–7.	Flooding hazard; plastic soils; high shrink-swell potential.
Loamy alluvial land:				
Lu	Generally fair but good in upper 10 inches.	Poor: sand and gravel stratified with silt.	Fair to poor: A–4 and A–6.	Subject to flooding
Lv	Generally poor but good in upper 6 inches.	Good below a depth of 10 to 20 inches; water table in gravel.	Fair to a depth of 20 inches; A–4; seasonal high water table. Good below depth of 20 inches; A–1.	High water table; subject to flooding.
Lw	Generally fair but good in upper 10 inches.	Good at a depth of 20 to 40 inches; seasonal water table at depth of about 3 feet.	Fair to poor to a depth of 36 inches; A–4 or A–6. Good below depth of 36 inches; A–1; seasonal water table at a depth of about 3 feet.	High water table; subject to flooding.
Nunn:				
NlA, NlB	Generally fair but good in upper 6 inches.	Unsuited: more than 50 percent fines; less than 5 percent gravel.	Fair to poor: A–4 to A–7.	High shrink-swell potential; A–4 and A–6.
NuA, NuB	Fair: clay loam	Unsuited: more than 50 percent fines; less than 5 percent gravel.	Fair to poor: A–4 to A–7.	Moderately plastic materials; A–4, A–6, and A–7.
Platner: PlB, PlC	Generally fair but good in upper 8 inches.	Poor: more than 50 percent fines; 10 percent sand and gravel below depth of 2 or 3 feet.	Fair to poor: A–4 to A–7.	Moderately plastic materials to depth of 2 or 3 feet.
Renohill: ReB, ReD	Fair to good: loam and clay loam; clay subsoil.	Unsuited: more than 50 percent fines; no gravel.	Poor: A–6 and A–7.	Moderately plastic materials; shale and sandstone at depth of 20 to 36 inches.
Rough broken land: Ro. Interpretations too variable to be estimated.				
*Samsil: SaE, ShF. For interpretations of Shingle soils in ShF, refer to Shingle series.	Poor: clay	Unsuited: more than 50 percent fines; no gravel.	Poor: A–7	Interbedded shale and sandstone at depth of 6 to 20 inches; contains gypsiferous layers.
Sandy alluvial land: Sm. Interpretations too variable to be estimated.				

See footnote at end of table.

interpretations of soils—Continued

Soil features affecting—Continued				Soil limitations for—	
Farm ponds		Agricultural drainage	Irrigation	Foundations for low buildings	Septic tank filter field[1]
Reservoir area	Embankment				
Slow permeability to a depth of 40 inches; slopes of 0 to 9 percent.	Low to medium shear strength.	Clay soils; flooding hazard; slow permeability in upper 40 inches.	Slow intake rate; needs drainage in places: flooding hazard.	Severe: flooding hazard; high shrink-swell potential.	Severe: slow permeability; slopes up to 9 percent; flooding hazard.
Moderately slow to moderate permeability; slopes of 0 to 3 percent.	Medium to low shear strength; medium to high piping hazard.	Nearly level; subject to flooding; poor outlets.	Moderate available water capacity.	Severe: subject to flooding.	Severe: subject to flooding.
Sites limited to dug ponds; high water table; subject to flooding.	Medium to low shear strength to a depth of about 20 inches; medium to high shear strength below depth of 20 inches; high piping hazard.	Subject to flooding; high water table is beneficial.	Low available water capacity; subject to flooding; beneficial high water table.	Severe: high water table; flooding hazard.	Severe: high water table; flooding hazard; hazard of pollution to streams.
Sites limited to dug ponds; seasonal water table; subject to flooding.	Medium to low shear strength to a depth of about 3 feet; high shear strength below depth of 3 feet; high piping hazard.	Subject to flooding; seasonal water table; poor outlets.	Moderately deep soil; seasonal water table: subject to flooding.	Severe: seasonal water table at depth of about 3 feet; subject to flooding.	Severe: seasonal water table at a depth of about 3 feet; flooding hazard; hazard of pollution to streams.
Moderately slow permeability; slopes of 0 to 3 percent.	Medium to low shear strength; medium piping hazard.	Moderately slow permeability; good outlets.	High available water capacity; moderate intake rate.	Severe: high shrink-swell potential.	Severe: moderately slow permeability.
Slow permeability; slopes of 0 to 3 percent.	Medium to low shear strength; medium piping hazard.	Slow permeability; good outlets.	Slow intake rate; needs drainage in places.	Moderate to severe: high shrink-swell potential.	Severe: slow permeability.
Slow permeability; slopes of 0 to 5 percent.	Medium to low shear strength; medium piping hazard below depth of 18 inches.	Slow permeability	Moderate to slow intake rate; high available water capacity.	Moderate to severe: moderate to high shrink-swell potential.	Slight to moderate: moderate permeability below depth of 18 inches.
Slow permeability; slopes of 1 to 9 percent; shale and sandstone at a depth of 20 to 36 inches.	Low shear strength	Slow permeability; shale and sandstone at depth of 20 to 36 inches.	Moderate intake rate; moderate available water capacity.	Severe: high shrink-swell potential.	Severe: slow permeability; slopes of 1 to 9 percent; bedrock at depth of 20 to 36 inches.
Slow permeability; slopes of 3 to 20 percent; shale and sandstone at depth of 6 to 20 inches.	Low to medium shear strength.	Slow permeability; uneven and moderately steep; bedrock at depth of 6 to 20 inches.	Not applicable	Severe: high shrink-swell potential; shale at depth of 6 to 20 inches.	Severe: shale and sandstone at depth of 6 to 20 inches; slopes of 3 to 20 percent; slow permeability.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
Satanta: SnA, SnB	Generally fair but good in upper 9 inches.	Unsuited: more than 50 percent fines; no gravel.	Poor to a depth of 48 inches; A-6. Fair to good below a depth of 48 inches; A-2 or A-4.	Moderate shrink-swell potential.
*Shingle: SrE For interpretations of Renohill soils in this unit, refer to Renohill series.	Poor: loam at depth of 10 to 20 inches over shale.	Unsuited: more than 50 percent fines; no gravel.	Fair: A-4; limited by sandstone and shale at depth of 10 to 20 inches.	Interbedded unstable sandstone and shale at depth of 10 to 20 inches.
Stoneham: StB, StD	Good to fair: loam and sandy clay loam.	Fair to poor for sand: 20 to 40 percent fines; less than 25 percent gravel.	Fair to good: A-2 to A-4.	Moderate shrink-swell potential to depth of about 1 foot.
Tassel Mapped only in complexes with Terry, Ulm, and Vona soils.	Poor: sandstone at depth of 10 to 20 inches.	Poor to unsuited: 40 to 55 percent fines; no gravel.	Fair: A-4; sandstone at depth of 10 to 20 inches.	Irregular topography; fine-grained sandstone at depth of 10 to 20 inches.
Terrace escarpments: Tc	Poor	Fair to good: extremely variable.	Good to fair: A-1 to A-4.	Steep slopes
*Terry: TeB, TeD, TrE, TsE For interpretations of Tassel soils in TrE and TsE, Ulm soils in TrE, and Vona soils in TsE, refer to their respective series.	Good to fair: sandstone at depth of 20 to 40 inches	Poor to unsuited: 35 to 55 percent fines; no gravel.	Fair: A-4	Severe hazard of soil blowing in borrow areas.
Truckton: TtB, TtD, TuB, TuC, TuD	Poor to fair: loamy sand to sandy loam.	Fair source for fine sand; no gravel.	Good: A-2 and A-3.	Hazard of soil blowing in borrow areas.
Ulm: UlB, UlC, UlD	Generally fair but good in upper 7 inches.	Unsuited: more than 50 percent fines; less than 15 percent gravel.	Poor: A-6 and A-7.	Moderately plastic materials; shale and sandstone below depth of 4 feet.
Valent: VaD	Poor: loamy sand	Fair where fine sands are desirable; poorly graded; no gravel.	Good: A-2 and A-3.	Severe hazard of soil blowing in borrow areas; low dunes.
*Vona: VnB, VnD, VoA, VoB, VoC, VsD For interpretations of Ascalon soils in VsD, refer to Ascalon series.	Fair to poor: loamy sand and sandy loam.	Fair source for sand; no gravel.	Good to fair: A-2 and A-4.	Moderate hazard of soil blowing in borrow areas.

See footnote at end of table.

interpretations of soils—Continued

Soil features affecting—Continued				Soil limitations for—	
Farm ponds		Agricultural drainage	Irrigation	Foundations for low buildings	Septic tank filter field[1]
Reservoir area	Embankment				
Moderate permeability; slopes of 0 to 3 percent.	Low to medium shear strength; medium to high piping hazard.	Moderate permeability; good outlets.	Moderate intake rate; high available water capacity.	Moderate: moderate shrink-swell potential.	Slight to moderate: moderate permeability.
Moderate permeability; slopes of 5 to 25 percent; shale and sandstone at depth of 10 to 20 inches.	Medium to low shear strength; high piping hazard.	Interbedded sandstone and shale at a depth of 10 to 20 inches; moderately steep.	Not applicable	Moderate: moderate shrink-swell potential; shale at depth of 10 to 20 inches.	Severe: bedrock at a depth of 10 to 20 inches; slopes of 5 to 25 percent.
Moderate permeability; slopes of 0 to 9 percent.	Medium shear strength; high piping hazard.	Not needed	Moderate to severe hazard of erosion.	Slight	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 9 percent.
Moderately rapid permeability; sandstone at a depth of 10 to 20 inches.	Medium shear strength.	Not applicable	Not applicable	Severe: slopes of 3 to 20 percent; sandstone at depth of 10 to 20 inches.	Severe: sandstone at depth of 10 to 20 inches; slopes of 3 to 20 percent.
High permeability; steep slopes.	Moderate to rapid permeability.	Not applicable	Steep slopes	Slight to severe: slopes of 1 to 80 percent.	Slight to severe: slopes of 1 to 80 percent.
Moderately rapid permeability; slopes of 0 to 20 percent.	Medium to low shear strength; medium piping hazard.	Moderately rapid permeability; sandstone at depth of 20 to 40 inches; irregular slopes.	Low available water capacity; rapid intake rate; hazard of water erosion on steeper slopes.	Moderate to severe: sandstone at depth of 20 to 40 inches; slopes of 0 to 20 percent.	Severe: slopes of 0 to 20 percent; bedrock at depth of 20 to 40 inches.
Rapid permeability; slopes of 0 to 9 percent.	Medium shear strength; medium to high piping hazard.	No adverse features, but drainage seldom needed.	Low to moderate available water capacity; erodible soil; slopes of 0 to 9 percent.	Slight	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 9 percent.
Shale and sandstone below depth of 48 inches; gypsum seams; slopes of 1 to 9 percent.	Low to medium shear strength.	Slow permeability; shale and sandstone below depth of 48 inches.	Commonly needs drainage; moderate salinity; moderate intake rate; moderate available water capacity.	Severe: moderate to high shrink swell potential to depth of 48 inches; shale below depth of 48 inches.	Severe: slow permeability.
Very rapid permeability; slopes of 1 to 9 percent.	Medium shear strength; medium to high piping hazard.	Not applicable	Low available water capacity; rolling slopes; erodible soil; slopes of 1 to 9 percent.	Slight	Slight where slopes are 1 to 5 percent; moderate where slopes are 5 to 9 percent.
Rapid permeability; slopes of 0 to 9 percent.	Medium shear strength; medium to high piping hazard.	No adverse features	Low to moderate available water capacity; erodible soils; slopes of 0 to 9 percent.	Slight	Slight where slopes are 0 to 5 percent; moderate where slopes are 5 to 9 percent.

TABLE 7.—*Engineering*

Soil series and map symbols	Suitability as a source of—			Soil features affecting—
	Topsoil	Sand and gravel	Road fill	Highway location
*Weld: WmB, WrB. For interpretations of Deertrail soils in WrB, refer to Deertrail series.	Generally poor but good in upper 6 inches.	Unsuited: more than 50 percent fines; no gravel.	Poor to fair: A-4 and A-7.	Moderately plastic materials; A-4 and A-7.
Wet alluvial land: Wt	Poor to fair: variable texture.	Fair to good below depth of 2 feet.	Poor: water table at depth of about 2 feet most of the time.	Poor drainage; frequent flooding.
*Wiley: WuE. For interpretations of Adena and Renohill soils in this unit, refer to their respective series.	Fair: clay loam below depth of 3 inches.	Unsuited: more than 50 percent fines; no gravel.	Fair to poor: A-4 and A-6.	Fair to poor compaction and stability; A-4 and A-6.

[1] Degree of limitation does not consider hazard of pollution to ground water.

Estimated properties significant to engineering

Table 6 shows some estimates of soil properties that are important to engineering. The estimates are based on field classifications and descriptions, physical and chemical tests of selected representative samples, test data from comparable soils in adjacent areas, and detailed experience in working with the individual kind of soil in the county.

The water table in most of the soils in the county remains at such a great depth that it is not significant to engineering. The water table in Loamy alluvial land, moderately wet, is at a depth of 3 feet and in Wet alluvial land is at a depth of 0 to 2 feet.

Most soils in the county are deep enough over bedrock that bedrock generally does not offset their use. Shale and sandstone are at a depth of about 28 inches in the Renohill soils, 12 inches in the Shingle soils, and 48 inches in the Ulm soils. Shale is at a depth of about 14 inches in the Samsil soils. Sandstone is at a depth of about 18 inches in the Tassel soils and 39 inches in the Terry soils.

The column headed "Depth from surface" indicates the depth of the soil material for which estimates were made. For these estimates, layers given in the technical profiles in the section "Descriptions of the Soils" were combined.

Listed for the soils in table 6 are the USDA textural classification, the Unified and AASHO engineering classifications, and the estimated percentages of material that passes Nos. 4, 10, 40, and 200 sieves. USDA texture is determined by the relative proportions of sand, silt, and clay in soil material that is less than 2.0 millimeters in diameter. "Sand," "silt," "clay," and some of the other terms used in the USDA textural classification are defined in the Glossary.

Permeability refers only to the rate that water moves downward through undisturbed and uncompacted soil material. It does not include lateral seepage. The estimates in table 6 are based on texture, structure, density, and porosity of the soils. Plowpans, surface crusts, and other properties resulting from use of the soils are not considered.

The available water capacity (also termed available moisture capacity), expressed in inches of water per inch of soil, is the capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. In table 6 it is expressed as inches of water per inch of soil.

Reaction indicates the degree of acidity or alkalinity of a soil, expressed as a pH value. The pH value, and relative terms used to describe soil reaction, are explained in the Glossary.

Salinity of the soil is based on the electrical conductivity of the saturated soil extract, as expressed in millimhos per centimeter at 25° C. Salinity affects the suitability of a soil for crop production, its stability when used as a construction material, and its corrosiveness to other materials.

Shrink-swell potential indicates the expected volume change of the soil material with changes in moisture content. Shrinking and swelling of soils causes much damage to building foundations, roads, and other structures. A high shrink-swell potential indicates hazards to the maintenance of structures constructed in, on, or with such materials.

Engineering interpretations

Table 7 gives selected information that is useful to engineers and others who plan to use soil material in construction of highways, farm facilities, buildings, and sewage disposal systems. The ratings and interpretations in this table are based on estimated engineering properties of the soils in table 6, and on field experience.

Topsoil is a term used to designate a fertile soil or soil material, ordinarily rich in organic matter, used to topdress lawns, gardens, roadbanks, and the like.

interpretations of soils—Continued

Soil features affecting—Continued				Soil limitations for—	
Farm ponds		Agricultural drainage	Irrigation	Foundations for low buildings	Septic tank filter field[1]
Reservoir area	Embankment				
Slow permeability; slopes of 1 to 3 percent.	Low to medium shear strength; medium to low piping hazard.	Slow permeability; good outlets; unstable ditch-banks; silty soil.	Moderate intake rate; good available water capacity.	Slight	Slight to moderate: moderate permeability below depth of 21 inches.
Sites limited to dug ponds; high water table; frequent flooding.	Variable deposit; piping hazard.	Limited outlets; frequent flooding.	Not applicable	Severe: high water table; frequent flooding.	Severe: high water table; flooding.
Moderately slow permeability.	Medium to low shear strength; medium to high piping hazard.	No adverse features.	High available water capacity.	Moderate: moderate shrink-swell potential.	Severe: moderately slow permeability.

Sand and gravel ratings are based on the probability that a given soil contains deposits of sand and gravel. The ratings do not indicate the quality or extent of the deposits.

Road fill is the material used for embankments and subgrades. Ratings are based on the performance of soil material borrowed for these purposes.

The selection of highway locations is influenced by those features of the soil in-place that affect the geographic location of highways. Evaluation is for the entire profile of an undisturbed soil that has not been artificially drained but that has had its organic surface layer removed, if one occurs.

The choice of a site for the reservoir of a farm pond depends largely on those soil features that affect the seepage rate of water through undisturbed soil in the impoundment area.

Soil features affecting pond embankments are those that influence the behavior of soil materials borrowed for earth embankments for farm ponds. Both the subsoil and substratum are considered if they have significant thickness.

Soil features affecting agricultural drainage are texture, stability, salinity, permeability, and a high water table.

Some of the features considered in evaluating a soil for irrigation are rate of water intake, available water capacity, slope, and susceptibility to soil blowing.

Soil features considered in rating limitations of soils for foundations for low buildings are those features of an undisturbed soil, to a depth of approximately 6 feet, that affect its suitability for supporting low buildings with normal foundation loads.

Features affecting septic tank sewage disposal are those features of the undisturbed soil that limit the absorption of effluent or that are in other ways a hazard here used for this purpose.

Corrosivity

Soils in Adams County that are corrosive are those of the Arvada, Heldt, Renohill, Samsil, Shingle, and Ulm series, especially where these soils are west of the South Platte River and north of Clear Creek. Some Platner soils in the same area are corrosive below a depth of 3 or 4 feet. The soils thus affected are underlain by shale or interbedded shale and sandstone and contain salts that cause hydrolysis when moist and commonly result in corrosion of some pipelines. This corrosive action is particularly damaging to metal pipe and fittings in water systems.

These soils generally contain sulfate salt concentrations that can be detrimental to concrete pipe and structures, and it is generally recommended that Type V cement be used.

Although the foregoing soils present the greatest hazard, corrosion is a hazard to some degree in soils throughout the county.

Community Development [7]

The southwestern part of Adams County is becoming largely urban and suburban because of the expansion of the cities of Aurora and Denver and an influx of light and heavy industry. It encompasses terrain ranging from uplands to flood plains. Among the developments are industrial sites along major transportation facilities, parks, race courses, golf courses, cemeteries, airports, shopping centers, small subdivisions for homesites and country estates, and complete self-contained communities, such as Montbello and Northglenn. West-facing slopes and high points are especially desirable for homesites and country clubs because of the spectacular view they afford of the Rocky Mountains. The flood plains of

[7] R. I. Blewitt, assistant State conservation engineer, helped to prepare this section.

this area are an excellent source of sand and gravel, and the dry pits are being utilized as sanitary fills. Many old gravel pits are filled with water from adjacent Clear Creek and South Platte River and are stocked with fish and used for boating.

Because so many areas are being covered by asphalt, concrete, and buildings, the erosion hazard from increased runoff must be taken into account in planning.

Continued growth and expansion is the expected trend, and this section of the soil survey points out the differences and limitations of the soils. The interpretations, as applied to community development, are generalized and should be used primarily for broad planning and in planning more detailed investigations where needed.

Several sections in this survey contain information useful as a general guide in community development. They should be helpful to planning and zoning boards and commissions and to those who develop areas for residential and other community uses. They should also be useful to the individual landowner.

The section on wildlife contains information and a table pertinent to this field. Basic information in regard to the suitability or limitations of the soils of Adams County for lawns and gardens can be found in the section "Use of the Soils for Cropland." The same kind of information is given for certain trees and shrubs in the section "Use and Management of the Soils for Trees and Shrubs."

The section on "Engineering Uses of the Soils" and the two tables in it contain a great deal of material useful to community planning. In the table "Engineering interpretations of soils," factors are given that affect the suitability of each soil in the county as a source of topsoil, sand and gravel, and road fill. A suitability rating of good, fair, or poor is also given.

Soil limitations for septic tank filter fields are listed as slight, moderate, or severe, and limiting factors are noted. This is useful for individual and small subdivision planning. It is assumed that public sewage disposal facilities are available to the larger communities.

Soil features affecting foundations for low buildings of not more than three stories are given. Many of the factors affecting the location of streets are in the column "Highway location." Soil features affecting the reservoir area and embankment of farm ponds can be used for guidance in planning sewage lagoons. The column on agricultural drainage should be helpful in reviewing drainage needs for residential or other development.

In the area west of the South Platte River and north of Clear Creek, many of the soils have characteristics that cause corrosion of metal and are detrimental to concrete pipe and structures. More information in regard to these problems can be found in the subsection "Corrosivity" in the section "Engineering Uses of the Soils."

In community growth, the prudent development and use of soils subject to frequent flooding or infrequent flooding is very important. This is particularly true along the flood plains where protection against infrequent floods is impractical or prohibitive in cost in places. This survey can be used as a guide in planning and zoning for the use of flood-plain resources, such as sand and gravel, and utilizing these areas for recreation and wildlife sanctuaries. It can also be useful to planners in avoiding the development of residences and businesses in areas subject to high financial loss or loss of life when severe floods occur.

Formation and Classification of the Soils

This section consists of two parts. The first part explains the formation of soils in this county. It tells how the main soil-forming processes have interacted to produce the various kinds of soil. The second part explains the classification of soils.

Factors of Soil Formation [8]

Soil is produced by the action of soil-forming processes on parent material that was deposited or accumulated by geologic forces. The characteristics of the soil at any given point are determined by (1) the physical and mineralogical composition of the parent material; (2) the climate under which the soil material accumulated and weathered; (3) the plant and animal life on and in the soil; (4) the relief, or lay of the land; and (5) the length of time the forces of soil development have acted on the soil material. The activities of man have also influenced the formation of soils.

Climate and vegetation are the active factors of soil formation. They act on the accumulated parent material and slowly change it into a soil that has genetically related horizons. The effects of climate and vegetation are conditioned by relief. The parent material also affects the kind of soil profile that forms and, in extreme instances, determines it almost entirely. Finally, time is needed for the changing of the parent material into a soil profile. The time needed may be long or short, but some time is always required for the development of horizons. Generally, a long time is required for the development of distinct horizons.

The factors of soil formation are so closely interrelated in their effects on the soil that few generalizations can be made regarding the effect of any one factor unless conditions are specified for the other four. Many of the processes that affect soil development are unknown.

Parent material

Differences in physical, chemical, and mineralogical properties of different materials have all been influential in soil genesis in Adams County. Generally, these differences in parent material affect soil properties that have been chosen for classifying soils at the series level, but they also affect properties that are useful in placing soils in higher categories in the classification system.

The parent materials in most of Adams County contain relatively large amounts of soluble compounds of calcium, magnesium, and, to a lesser degree, sodium. Carbonates and sulfates are the predominant anions, and there are minor amounts of chloride and nitrates. A reduction in the concentration of the metallic ions is necessary before there can be appreciable translocation of

[8] ARVID J. CLINE, soil correlator, Soil Conservation Service, prepared this section.

silicate clays. Most of the soils that have distinct horizons have been leached of these salts in their upper part and have distinct accumulations of secondary calcium carbonate and other salts below the solum.

The texture and other physical characteristics of the parent material also influence soil genesis. Thus, soils formed in eolian sand form at different rates or through a different set of genetic processes than soils formed in fine-textured, residual material.

Generally, the parent material of the soils of Adams County is of mixed mineral composition. The soils of the Truckton and Blakeland series, however, formed in parent material derived principally from granite bedrock or arkose deposits of the Denver and Arapahoe formations. The parent material of these soils is relatively high in feldspar and quartz and is much lower in free calcium or readily soluble calcium compounds than other parent materials of the county.

A few of the parent materials of the soils in Adams County contain significant amounts of sodium that have strongly influenced soil genesis. Under the influence of sodium ions, the collodial clays disperse, and soils that formed have a fine-textured, distinct B2t horizon overlain by a light-colored, leached horizon. Typically, the content of sodium in such soils is high enough that the soils are toxic to most plants. Such soil areas are characterized by nearly barren spots frequently called buffalo wallows or slickspots. The Arvada series is an example.

Six major kinds of parent material are recognized as having been influential in the formation of the soils of Adams County: (1) Residual material from sedimentary rock; (2) fan alluvium from sedimentary rock; (3) eolian materials; (4) general pedisediments derived from the Rocky Mountain system; (5) general pedisediments derived from arkose beds; and (6) mixed alluvium of major river systems.

Where sedimentary bedrock is near the surface, the soils generally form in sediments weathered from the underlying bedrock with only minor amounts of transportation. If the parent rock was uniform in character for some depth, the sediment weathered from it retained the properties of the underlying bedrock. Thus, sediments underlain by fine-textured calcareous shale is fine textured and calcareous. Where the parent rock was stratified and variable in character, the overlying sediments also vary in characteristics with depth. They may or may not conform to the characteristics of the present rock that immediately underlies them.

Generally, most of the sedimentary bedrock in Adams County is either clayey or loamy soft shale or relatively fine-grained sandstone. Soil texture varies, depending upon the nature of the parent rock, and loam, clay loam, and clay are dominant. Typically, these materials are strongly calcareous throughout, and carbonates or sulfates of calcium and magnesium are dominant. Seams of gypsum crystals are common in the parent rocks and in the lower parts of the sediments weathering from them. Local concentrations of sodium salts are present in places.

The alluvial fan sediments derived from the sedimentary rock have most of the characteristics described for the residual sediments weathered from such beds, but they have been transported and more thoroughly graded. Texture is generally less variable, and the materials tend to be more homogenous.

Most of the eolian deposits in the county are loam, silt loam, or very fine sandy loam and contain a relatively large amount of very fine sand. Generally, these are well-mixed materials high in calcium carbonate, and in places they contain significant amounts of sodium. Significant acreages of eolian loamy fine sand or fine sand are in parts of the county, and areas of wind-deposited coarser sand border some of the streams draining the areas of the arkose beds.

Much of Adams County is covered by the Tertiary and Pleistocene sediments originating at the eastern edge of the Rocky Mountain system. These deposits are variable in texture from place to place, but they are dominantly sandy loam, sandy clay loam, or clay loam. Strata of sand and variable contents of gravel and cobblestones are typical of these beds. Chemically they are high in calcium and magnesium carbonate and sulfate. Their mineralogy is mixed and variable.

Sediments derived from beds of the Denver and Arapahoe arkose formations are common in parts of the county. These deposits differ from the sediments derived from the Rocky Mountain system in having a high proportion of medium and coarse angular sand weathered from granite bedrock. Although generally base saturated, these deposits contain little free calcium carbonate. Their mineralogy is largely inherited from Pikes Peak granite. They are high in silica and feldspar. They are dominantly coarse sandy loam or sandy clay loam. Blakeland and Truckton soils formed in these materials.

Along the major stream valleys are extensive deposits of recent alluvium derived from a variety of sources. All of these deposits are highly stratified and variable from place to place. Texture ranges from sand to clay, and strongly contrasting textural stratification characterizes many of the soils. With the exception of the material on the flood plains of the streams draining the arkose beds, these materials are high in calcium and magnesium carbonate and sulfate. Not infrequently, ground water has concentrated soluble salts into discontinuous visible deposits within a 5-foot depth. Unlike the other parent sediments of the area, these deposits have a content of organic carbon that varies erratically with depth or from strata to strata.

Climate

The climate of Adams County is of the semiarid, continental type. It has cold, dry winters and cool, relatively dry summers. The average precipitation and average temperature data, as measured at the weather stations in or near the county, are given in the section "Climate", p. 69.

A limited amount of information on soil temperature is available for this county. This information indicates that the average annual soil temperature, measured at a depth of 20 inches, is approximately 53° F., and the average soil temperature in summer (June, July, and August), measured at a depth of 20 inches, is approximately 70°. Sandy soils range from 1 to 2 degrees warmer than clay soils in both average annual soil temperature and average summer soil temperature. Cultivated soils also are typically 1 to 2 degrees warmer

than the soils that remain in grass. Soils influenced by a fluctuating water table appear to have nearly the same average annual temperature as those of well-drained soils, but their average summer temperature, at a depth of 20 inches, is typically 3 to 4 degrees cooler. Soil temperatures at a depth of 20 inches are typically above 41° for approximately 250 days of most years. The soils typically have a temperature below 41° from about December 18 until April 10, and a temperature above 41° for the rest of the year.

The soils of Adams County store moisture in excess of evaporation and transpiration losses, starting sometime during the early part of November and continuing more or less continuously until about June 15. On or about June 15 of most years, the moisture supply in the upper 3 to 12 inches of the soil has been depleted below the wilting point, and growing plants must depend upon periods of summer rainfall for additional growth. Although moisture is received during part of this period in excess of 1 inch per month, the rains typically fall as showers and wet the soil for brief periods, typically less than 2 weeks at a time, throughout the late summer months.

The affect of climate on soil formation can only be approximated. Recorded weather data cover only a period of 20 to 50 years, whereas the time required for the formation of the soil horizons in this area is measured in thousands of years. It would be unsound to assume that the recorded data represent a true picture of the climate, or even a major part of it, during the genetic history of the soil. It is possible, however, to draw logical parallels between general characteristics of the climate and general characteristics of the soil. Such an approach to the genetic impact of climate is of considerable value in the understanding of soil genesis, even though it is recognized that the climatic history of the soil cannot be reconstructed in its entirety.

The amount of water available and the distribution of water in relation to temperature are of prime importance to soil genesis. They play a major role in the growth and activity of organic life in and on the soil, in the physical translocation of substances in solution or suspension, and in controlling the rate of chemical processes. If it is assumed that the present rates and patterns of precipitation relative to temperature are representative of average conditions throughout the entire period of soil formation, it is logical to expect that with peak periods of precipitation coinciding with peak periods of plant growth, there would seldom be periods when soil moisture penetrated beyond the maximum root zone of common plants.

Although the calculation of excess soil moisture over evaporation and transpiration needs is always subject to error, a study of such data indicates that, in average years in Adams County, less than 3 inches of available moisture is stored at any one time in a soil that has native grass vegetation. This would mean that moisture supply sufficient for the translocation of soluble salts in solution or colloids in suspension would normally not penetrate much below 12 inches in medium-textured or moderately fine textured soils. Visible accumulations of secondary calcium carbonate at depths of 7 to 14 inches in the Adena, Heldt, Stoneham, Weld, and Wiley soils represent about the amount of translocation of lime expected.

In some of the soils in Adams County having disti[illegible] horizons, a visible accumulation of secondary calcium carbonate is at a slightly greater depth, ranging from 15 to 20 inches. Soils of the Platner, Renohill, Satanta, and Ulm series are examples. This does not greatly differ from the theoretical calculations but does indicate that, historically, the average climate of this area may have been somewhat more moist than the present climatic data would indicate. Because the period of time that man has measured climatic variations is so short in comparison to the total time of soil formation, it is questionable whether data from present weather stations actually measure a true average of climatic conditions during genesis of the soils.

The relationship between temperature and soil morphology in Adams County is more obscure than that between precipitation and soil morphology. This obscurity is partly caused by the lack of significant variation of temperature within the county, and partly by the fact that, in this area, temperature influences soil genesis mainly by controlling the effectiveness of moisture. Thus, the effect of temperature is so closely related to the effect of precipitation that it is impossible to separate them precisely.

The warm summer temperatures that coincide with periods of maximum precipitation in this area materially decrease the effectiveness of moisture that falls in spring and early in summer. During this time plant growth is at its maximum, and the demands made by the plants for soil moisture are relatively great. In terms of the amount of soil moisture that would be available for t[illegible] translocation of soluble salts or colloidal materials in t[illegible] soil, the result is the same as that of a reduction in the total amount of precipitation. Consequently, the effectiveness of the available supply of moisture is less than if peak periods of moisture occurred during the cooler months of the year when plant growth was at a minimum.

Temperature influences soil genesis in other ways, but the precise effect is difficult to characterize. For example, soil temperature strongly influences microbiological activity, which is important in soil genesis. Soil temperature also affects the rate of growth and total time in which plants grow in the soil and in this way also influences soil genesis.

Biological zero is generally considered to be 41° F. Above this temperature both plants and micro-organisms grow at increased rates as temperature increases, but below this level the activity of plant and microbiological life is relatively low. The soils of Adams County are warmer than 41° F. for approximately 250 days out of the year. During a significant part of this period, however, the amount of soil water is below the wilting point, and therefore, even though the temperature is favorable to maximum plant and micro-organism growth, the supplies of available moisture are not.

Other effects of temperature on plant growth and chemical activity can be shown, but it is impossible to evaluate the results precisely. Moreover, it is important to an understanding of soil genesis in Adams County not to consider temperature and precipitation as separate and distinct factors. It is the combined effect of temperature and precipitation, as well as the other factors

soil genesis, that result in the formation of a specific kind of soil.

Living organisms

Living organisms that affect soil formation can be divided on the basis of physical size into macro and micro groups. The macrobiological group includes the visible plants and animals that live in or on the soil. Microbiological life consists of organisms too small to be seen with the unaided eye. They occur in great numbers and have a pronounced effect on soil genesis. In Adams County both are significant to soil genesis. However, the effect of animal life is localized into specific areas.

Adams County is a grassland area, and trees occur naturally only on the flood plains of the major streams. As far as can be determined, this type of native plant cover has persisted throughout the major part of the soil genetic history, and the kinds of soil found in the county have characteristics that are to be expected from soils of the grasslands. The consistency of vegetative pattern throughout the genetic history of the soils of Adams County is substantiated by the study of buried soil profiles presumed to be several thousand years old that have the same kind and magnitude of morphology as those found in modern landscapes.

The type of natural vegetation does not differ greatly between different parts of the county. Consequently, soil differences resulting from differences in vegetation are small and are generally confined to those resulting from different amounts of vegetation.

All of the soils of Adams County formed under a type of genesis involving a yearly return of organic materials to the soil and its decomposition in the presence of an abundance of calcium ions. From the short grasses typical of this area, more organic matter is returned to the soil by the decomoposition of the plant root system than from the surface addition derived from yearly fall of the aboveground parts of the plant. Because of this distribution pattern, dark-colored horizons that are relatively high in organic material extend well into the soil profile in places instead of being confined only to the surface horizon.

The amount of vegetation varies from place to place in the landscape, depending upon the amount of available soil moisture. Thus, minor soil differences resulting from different amounts of vegetation are common within any one landscape. The soils that have a dark surface horizon, and those where dark colors extend for greater depths, occupy the more nearly level or slightly concave topographic positions.

The effect of living animal life on the soils of Adams County is less easily distinguished. This does not imply that it is unimportant or that it does not exist, but only that it is approximately uniform for most soils of the area. Careful examination of the soils in almost any location shows some evidence of mechanical soil mixing by earthworms, ants, or burrowing rodents. All have contributed to mixing of the soil. Although the common prairie dog has nearly been eradicated in this area, intensive areas of soil mixing within old prairie dog towns can still be found.

The activity of insects, worms, and rodents is widespread throughout the county, but there is some selectivity shown by each for certain soils. Thus, wet soils show less gopher activity than dry, and worms or insects tend to select soils having temperatures that are best suited to their habits.

Relief

Soil genesis in Adams County is affected by relief, mainly as a result of the character of landform on the control of soil moisture. The steepness of the slope, its position relative to other soil areas, and the shape of its surface all affect the genesis of soils in this area.

Moderately sloping areas lose a part of their yearly moisture supply, falling as rainfall, through runoff. Consequently, there is less soil moisture to leach the soil, to transport colloidal substances, or to support vegetative life. Soils in Adams County having moderate slopes are generally thiner, more calcareous, lighter colored, and have less distinct horizons than the soils having gentle slopes.

Soils that are steep not only lose much of their yearly moisture supply, but they undergo yearly erosion losses as well. Such erosion generally is not rapid enough to be readily noticed, but over long periods of time it removes enough soil to prevent distinct soil horizons from forming.

Gently sloping soils on lower foot slopes, below areas where runoff is rapid, receive not only the rain that falls on them but also rainwater that runs off higher lying soils. Consequently, such areas have more water available for soil genetic processes than that supplied by the normal climate of the area. In Adams County the Dacona, Nunn, and Satanta soils that occupy these positions tend to be thicker, darker colored, and more thoroughly leached, and they have more distinct horizons than the more sloping soils.

Areas of the landscape having a concave surface tend to concentrate runoff water in their lower part. Such areas also receive more water than is normally supplied by rainfall and tend to form a soil profile like those of gently sloping soils on lower foot slopes.

In a few areas in Adams County, enclosed depressions trap runoff water to form small, intermittent lakes. Soil genesis in such areas is strongly influenced by excess water at some seasons that prevents plant growth and deposits silt and soluble salts.

Time

If the effects of all other soil-forming factors are equal, the parts of any given landscape that have been subjected to soil-forming processes for the longest period of time have the most distinct soil horizons, but the precise chronological age of a soil is not easily measured. Unless specific dating can be accomplished by geomorphic or archaeological studies, or by determining the degree of decay of radioactive substances, the age of the soil can be stated only in relative terms based on comparisons of soil morphology. Although precise data on chronological age is lacking for this country, its landscapes can be grouped into three general age groups based on the chronological age of parent material; (1) flood plains, terrace systems, and adjoining alluvial fans of major drainage systems, (2) table lands and uplands capped by loess deposits of intermediate age, and (3) uplands in which soil parent materials consist of regional, Tertiary, and Pleistocene pedisediments forming

as fans from the base of the Rocky Mountain system, or in which parent sediments of considerable thickness have weathered from underlying bedrock.

The first of these groups is in moderate acreages along the drainageways of the South Platte River and Kiowa, Bijou, and Badger Creeks or their major tributary streams. In terms of both soil genesis and chronology, the soils in these areas are young and have little or no horizon formation other than a darkened surface horizon or weak and inconsistent accumulation of calcium carbonate or other soluble salts. The flood plains and low terraces are still actively building, and they receive additional deposition with each flood. The materials of such areas (Loamy alluvial land, Sandy alluvial land) are commonly so youthful that a distinctly darkened A horizon has not formed. The higher terraces, side slopes of alluvial fans, and recent eolian deposits are somewhat more stable, and their soils generally have distinct horizons. Soils typical of this first group are the Blakeland, Colby, Heldt, and Valent.

Chronologically, the parent materials for the soils of the second group are younger than those of the third. Stratagraphically, they are above the regional beds of pedisediments. In terms of soil genesis, there is some question as to which of the two is the older. There is always the possibility that landscapes containing the pedisediments or residual materials have formed as the result of an erosion cycle after the deposition of the loess. It is probable that, in terms of soil chronology, the age of the landscapes in the third group is both older and younger than that of the second.

The soils of the second group, which are on the stable parts of the landscapes, typically have a dark surface horizon, are fine textured, have distinct B2t horizons, and have well-formed horizons of secondary carbonate accumulation. Examples are the Deertrail, Nunn, and Weld soils. These are all characteristics of mature grassland soils, and it can therefore be assumed that the stable parts of the landscapes are moderately old. It is significant that these kinds of landscapes have a very uniform soil pattern, indicating that the genetic age of the soil is uniform within them.

The character of the soils in the third group is more variable. Some soils have general characteristics similar to those described in the second group. Other soils have a less distinct surface horizon, have a medium-textured to moderately fine textured, moderately distinct B2t horizon, and have distinct continuous horizons of secondary calcium carbonate accumulation. This variability suggests that the genetic age of these soils also varies, and that some landscapes are much older than others. Soils of this group include the Platner, Renohill, Samsil, Shingle, Stoneham, Tassel, Terry, and Ulm.

In most landscapes of the second and third groups, there are some soils that have youthful characteristics. Chronologically, these areas may be as old as those around them, but they occupy the parts of the landscape where geologic erosion is most active. In such areas rates of removal have kept pace with soil formation. Consequently, a soil that has distinct horizons has never been able to form, even though soil-forming processes have been active for long periods of time.

Activities of man

Although not generally accorded an equal status wi other soil-forming factors, the activities of man unquestionably have influenced, and will continue to influence, the soil genesis in Adams County. The effect may be relatively minor, or it may be catastrophic in terms of soil morphology. Catastrophic results include the destruction of soil horizons by accelerated erosion, by tillage, or by leveling in preparation for irrigation. The collection of brackish, salt-carrying water is common in lower parts of the landscape as a result of seepage from irrigation or from disturbance of the natural drainage pattern. Less severe effects include changes in general environment, such as that resulting from irrigation, overgrazing, or the destruction of native vegetation and substitution of tilled crops and other plant species.

The duration of man's influence on soil genesis has been so short that it has not resulted in major changes in soil morphology, except in those places where some part of the soil has been destroyed. In Adams County the most noticeable results are the depletion of organic matter from the layers of tilled soils, the alteration of the natural level of fertility by continuous cropping or conversely by supplemental fertilization, and changes that have resulted from irrigation.

Classification of Soils

Classification consists of an orderly grouping of soils according to a system designed to make it easier to remember soil characteristics and interrelationships. Classification is useful in organizing and applying the results of experience and research. Soils are placed i narrow classes for discussion in detailed soil surveys and for application of knowledge within farms and fields. The many thousands of narrow classes are then grouped into progressively fewer and broader classes in successively higher categories, so that information can be applied to large geographic areas, such as countries or continents.

Two systems of classifying soils have been used in the United States in recent years. The older system was adopted in 1938 *(2)* and revised later *(4)*. The system currently used by the National Cooperative Soil Survey was developed in the early sixties and was adopted in 1965 *(3, 6)*. It is under continual study.

The current system of classification has six categories. Beginning with the most inclusive, these categories are the order, the suborder, the great group, the subgroup, the family, and the series. The criteria for classification are soil properties that are observable or measurable, but the properties are selected so that soils of similar genesis are grouped together. The placement of some soil series in the current system of classification, particularly in families, may change as more precise information becomes available.

Table 8 shows the classification of each soil series of Adams County by family, subgroup, and order, according to the current system.

Following are brief descriptions of each of the six categories in the current system.

ORDER: Ten soil orders are recognized in this system. They are Entisols, Vertisols. Inceptisols, Aridisols, Mo

lisols, Spodosols, Alfisols, Ultisols, Oxisols, and Histosols. The properties used to differentiate the soil orders are those that tend to give broad climatic groupings of soils. Three exceptions, the Entisols, Inceptisols, and Histosols, occur in many different climates.

SUBORDER: Each order is divided into suborders, primarily on the basis of those soil characteristics that produce classes having the greatest genetic similarity. The suborders narrow the broad climatic range permitted in the orders. The soil properties used to separate suborders mainly reflect either the presence or absence of waterlogging or soil differences resulting from the climate or vegetation.

GREAT GROUP: Suborders are separated into great groups according to the presence or absence of genetic horizons and the arrangement of these horizons. The horizons used to make separations are those in which clay, iron, or humus has accumulated or those that have pans that interfere with the growth of roots or the movement of water. The features used are the self-mulching properties of clay, soil temperature, major differences in chemical composition (mainly calcium, magnesium, sodium, and potassium) and the like. The great group is not shown separately in table 8, because it is the last word in the name of the subgroup.

SUBGROUP: Each great group is subdivided into subgroups. One of these subgroups represents the central, or typic, segment of a group, and the others, called intergrades, contain those soils that have properties mostly of one great group, but also one or more properties of soils in another great group, suborder, or order. Subgroups may also be made in those instances where soil properties intergrade outside of the range of any other great group, suborder, or order.

FAMILY: Each subgroup is divided into families, primarily on the basis of properties important to the growth of plants or to the behavior of soils when used for engineering. Among the properties considered are texture, mineralogy, reaction, soil temperature, permeability, thickness of horizons, and consistence.

A detailed profile of the representative soil for each of the series is given in the section "Descriptions of the Soils." In the following pages each of the subgroups represented in Adams County is discussed in terms of its definitive morphology. A series typical of each group is identified, and significant differences between this series and others in the same group are noted.

Ustic Torripsamments.—The soils of this subgroup formed under grassland vegetation in areas of deep eolian sands. Average annual precipitation is approximately 13 inches. The annual temperature is about 55° F., and average soil temperature in summer is approximately 73°. Most areas of these soils characteristically have a dunelike topography.

Virgin soils of the group have an A, C horizon sequence. The A horizon is thin and is only slightly darker colored than the C horizon. Typically this horizon has a weak granular structure and is soft to loose when dry. The C horizon is single grain, loose when dry or moist, and noncalcareous for more than 40 inches. Texture is typically loamy fine sand or fine sand.

This subgroup is represented by the Valent series in Adams County.

Ustic Torriorthents.—The soils of this subgroup in Adams County formed under grassland vegetation in parent materials weathered residually from sedimentary bedrock or in young eolian deposits. Typically, these soils are moderately steep to steep on parts of the landscape where geologic erosion has been most active. They are in areas having an average annual precipitation of about 13 to 14 inches, an average annual soil temperature of about 53° F., and an average summer soil temperature of about 70°.

TABLE 8.—*Soil series classified according to the current system of classification*

Series	Family	Subgroup	Order
Adena	Fine, montmorillonitic, mesic	Ustollic Paleargids	Aridisols.
Arvada	Fine, montmorillonitic, mesic	Ustollic Natrargids	Aridisols.
Ascalon	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Blakeland	Sandy, mixed, mesic	Torriorthentic Haplustolls	Mollisols.
Colby	Fine-silty, mixed, calcareous, mesic	Ustic Torriorthents	Entisols.
Dacono	Clayey over sand or sandy-skeletal, montmorillonitic, mesic.	Aridic Argiustolls	Mollisols.
Deertrail	Fine, montmorillonitic, mesic	Haplustollic Natrargids	Aridisols.
Heldt	Fine, montmorillonitic, mesic	Ustertic Camborthids	Aridisols.
Nunn	Fine, montmorillonitic, mesic	Aridic Argiustolls	Mollisols.
Platner	Fine, montmorillonitic, mesic	Abruptic Aridic Paleustolls	Mollisols.
Renohill	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Samsil	Clayey, montmorillonitic, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Satanta	Fine-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Shingle	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Stoneham	Fine-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Tassel	Loamy, mixed, calcareous, mesic, shallow	Ustic Torriorthents	Entisols.
Terry	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Truckton	Coarse-loamy, mixed, mesic	Aridic Argiustolls	Mollisols.
Ulm	Fine, montmorillonitic, mesic	Ustollic Haplargids	Aridisols.
Valent	Mixed, mesic	Ustic Torripsamments	Entisols.
Vona	Coarse-loamy, mixed, mesic	Ustollic Haplargids	Aridisols.
Weld	Fine, montmorillonitic, mesic	Abruptic Aridic Paleustolls	Mollisols.
Wiley	Fine-silty, mixed, mesic	Ustollic Haplargids	Aridisols.

The virgin soils of this subgroup typically have an A, C (or R) horizon sequence. In places, weak and intermittent Cca horizons are present. The A horizon is thin and only slightly darker colored than the C horizon. The A horizon is soft when dry and very friable when moist in most instances, but it varies in consistence, depending upon the texture. Typically, these horizons have a fine granular structure and are calcareous. The C horizon is calcareous and massive. Consistence ranges from slightly hard to very hard when dry, depending upon texture. Weak and intermittent accumulation of secondary calcium carbonate or calcium sulfate are present in some of these horizons.

This subgroup is represented in Adams County by the Colby, Samsil, Shingle, and Tassel series. The Colby soils are representative of the subgroup.

The Tassel soils differ from the Colby soils in having formed in parent materials weathered residually from underlying sandstone, in having sandstone bedrock at depths of less than 20 inches, and in having a sandy loam texture.

The Shingle soils differ from the Colby soils in having formed in parent sediments weathered residually from underlying shale and limestone, and in having unweathered bedrock at a depth of 10 to 20 inches.

The Samsil soils differ from the Colby soils in having a clay texture, in having formed in parent materials weathered from underlying shale, and in having unweathered shale bedrock at depths of 6 to 20 inches.

Ustertic Camborthids.—The soils of this subgroup formed under grassland vegetation in fine-textured parent materials locally transported from calcareous, fine-textured shale. They are in an area having an average annual precipitation of about 13 inches, an average annual soil temperature of about 53° F., and an average soil temperature in summer of about 71°. They typically are very gently sloping on lower parts of valley-filling side slopes.

Virgin soils of this group have an A1, B2, Cca horizon sequence. The A horizon is thin, has moderate granular structure, is soft to slightly hard when dry, and is only slightly darker colored than the underlying horizon. The A horizon typically is calcareous throughout, but it is leached of free lime for a few inches in places.

The B2 horizon typically has brighter chroma than either the overlying A horizon or the underlying C horizon. It is fine textured, is calcareous, and has moderate grades of medium to coarse prismatic structure parting to angular blocky structure. This horizon cracks widely on drying, and shiny pressure surfaces are common on the faces of the aggregates. When dry, the mass breaks readily into the primary aggregates, but the aggregates themselves are extremely hard. The horizon is calcareous but lacks visible accumulation of secondary calcium carbonate or calcium sulfate.

The C horizon is calcareous and fine textured, but it lacks the moderately well formed structure of the overlying B2 horizon. This horizon also cracks widely on drying, forming large, irregularly shaped, angular blocks that are extremely hard when dry. Distinct and continuous horizons of visible secondary calcium carbonate and calcium sulfate accumulation are present.

This subgroup is represented in Adams County by the Heldt series.

Ustollic Natrargids.—The soils of this subgroup formed under grassland vegetation in parent materia that are derived principally from sedimentary rock. Th average annual precipitation is approximately 13 inches. The average annual soil temperature is about 52° F., and the average soil temperature in summer is about 70°. These soils are gently to moderately sloping on uplands below areas of outcrops or shallow soils forming in material weathered from sedimentary bedrock.

Virgin soil profiles have an A1, A2, B2t, B3casa, Ccasa horizon sequence. The A1 horizon, if present, is thin, light colored, friable, and granular. Commonly, this horizon is absent or has been destroyed. The A horizon is typically noncalcareous.

The A2 horizon is very light colored, typically is noncalcareous, and has a distinct, thin, platy structure parting to fine granular structure. It is a horizon of eluviation and abruptly overlies the B2t horizon.

The B2t horizon is fine textured and has a distinctive columnar structure. The upper parts of the aggregates are well rounded where they contact the A2 horizon. The soil mass is only slightly hard to hard, but the individual soil aggregates are extremely hard when dry. Moderate, continuous clay films coat most of the aggregate faces. This horizon is typically noncalcareous in the upper part, but it is calcareous in the lower part. It is strongly to very strongly alkaline throughout.

The B2t horizon is underlain by a transitional horizon that retains some of the structure and properties of the overlying B2t horizon, but in which there is a continuous accumulation of calcium carbonate and other salts.

The C horizon is massive, calcareous, and typical strongly alkaline. It is typically loam or clay loam. Distinct and continuous accumulations of calcium carbonate, calcium sulfate, and other salts are present in the C horizon.

This subgroup is represented in Adams County by the Arvada series.

Haplustollic Natrargids.—The soils of this subgroup in Adams County formed under grassland vegetation in deep deposits of eolian sediments. The average annual precipitation is about 13 inches. The average annual soil temperature is about 52°, and the average soil temperature in summer is about 70°. These soils typically are nearly level to very gently sloping on uplands.

In the virgin state, these soils have an A1, A2, A&B2, B21t, B22t, B3ca, Cca horizon sequence. The A horizons are thin but are typically moderately dark colored. They are generally noncalcareous, have friable consistence, and have a moderate granular structure.

The A2 horizon is relatively thin but continuous. It is very light colored, has platy structure, and is typically noncalcareous. This horizon has strong eluviation.

The upper part of the B2t horizon is fine textured, is noncalcareous, and has strong, medium, columar structure parting to strong, fine, angular blocky structure. The upper parts of the columns are well rounded where they contact the A2 horizon, but there is no appreciable fingering of the A2 material into the B2t horizon. Continuous clay films coat the faces of aggregates. The horizon parts readily into primary aggregates, but these are extremely hard when dry. Although the upper pa of the B2t horizon has the characteristics of th

Natrargids, it does not have the necessary 15 percent exchangeable sodium percentage.

The lower part of the B2t horizon is fine textured, has moderate, fine, prismatic structure parting to fine, angular and subangular blocky structure, and is typically calcareous. The soil mass is slightly hard to hard when dry, but the individual aggregates are extremely hard when dry. Thin, continuous clay films are on the surfaces of most of the soil aggregates in this horizon. This part of the B2t horizon is very strongly alkaline and has exchangeable sodium percentage in excess of 15 percent.

Below the B2t horizon is a transitional B3ca horizon that has retained some of the characteristics of the B2t horizon, but in which there is distinct and continuous accumulation of calcium carbonate and other salts, principally as concretions and crystals.

The Cca horizon is medium textured, calcareous, and very strongly alkaline. The horizon is massive and contains accumulations of secondary calcium carbonate and other salts.

This subgroup is represented in Adams County by the Deertrail series.

Ustollic Paleargids.—The soils of this subgroup in Adams County formed under grassland vegetation in areas of eolian parent materials. The average annual precipitation is about 13 inches, the average annual soil temperature is about 52° F., and the average soil temperature in summer is about 72°. These soils are very gently sloping to nearly level on tablelands.

The virgin soils have an A1, B2t, B3ca, Cca horizon sequence. The A1 horizon is thin, noncalcareous, and ly slightly darker colored than the underlying B2t horizon. The horizon typically has moderate to fine, granular structure and is soft when dry and very friable when moist. The horizon is noncalcareous and abruptly overlies the B2t horizon. It is typically loam or very fine sandy loam.

The B2t horizon is fine textured, is noncalcareous, and has very strong, fine, prismatic structure that parts to strong, fine, angular blocky structure. The soil mass is only slightly hard when dry, but individual aggregates are extremely hard when dry. Moderate, continuous clay films are on the surfaces of most soil aggregates.

Below the B2t horizon is a transitional B3ca horizon that has retained some of the properties of the B2t horizon but that, in addition, contains visible accumulations of calcium carbonate, principally in the form of concretions of thin seams and streaks.

The Cca horizon is medium textured, massive, and calcareous. It contains consistent accumulations of calcium carbonate in the upper part, but the material is strongly calcareous throughout.

This subgroup is represented in Adams County by the Adena series. Soils of the Adena series typically have a solum less than 15 inches thick, which is thinner than most of the soils in this subgroup in other areas.

Ustollic Haplargids.—The soils of this subgroup in Adams County formed under grassland vegetation in a variety of parent materials. The average annual precipitation is about 13 inches, the average annual soil temperature is about 52° F., and the average soil temperature in summer is about 70°. These soils typically are gently moderately sloping on well-drained uplands.

The virgin soils typically have an A1, B1, B2t, B3ca, Cca (or R) horizon sequence. The A1 horizon is relatively thin and only slightly darker colored than the rest of the soil profile. Typically, it has fine, granular structure, is noncalcareous, and is soft to slightly hard when dry.

Typically, a thin transitional B1 horizon is between the A1 and B2t horizons. This horizon has retained the color of the A1 horizon, but has the structure and evidence of clay accumulations that are characteristic of the B2t horizon.

The B2t horizon is typically noncalcareous and has a prismatic structure parting to subangular blocky structure. Consistence of the soil mass ranges from slightly hard to hard when dry, but that of individual aggregates ranges from slightly hard to extremely hard, depending upon their texture. Typically, most of the B2t horizon is noncalcareous; however, the lower part of the B2t horizon may effervesce with acid in some locations. Clay accumulation in the form of clay films or clay bridges is evident in this horizon.

Below the B2t horizon generally is a transitional B3ca horizon that has retained some of the characteristics of the B2t horizon but that, in addition, has visible accumulations of secondary calcium carbonate.

The Cca horizon typically is massive, is calcareous, and contains accumulations of secondary calcium carbonate or calcium sulfate. Consistence ranges from slightly hard to extremely hard when dry, depending upon texture. In most places the Cca horizon is coarser textured than the B2t horizon.

This subgroup is represented in Adams County by the Renohill, Stoneham, Terry, Ulm, Vona, and Wiley series. The Renohill series is representative of the subgroup.

The Terry soils differ from the Renohill series in having a sandy loam B2t horizon and in being underlain by soft sandstone bedrock. The Vona soils differ from the Renohill soils in having a sandy loam B2t horizon and in lacking bedrock at a depth of less than 40 inches. The Stoneham soils differ from the Renohill soils in having a loam or clay loam B2t horizon, in having a solum less than 15 inches thick, and in lacking bedrock at a depth of less than 40 inches. The Wiley soils differ from the Renohill soils in having less distinct horizons, in having formed in fine, silty, mixed eolian sediments, and in lacking bedrock at a depth of less than 40 inches. The Ulm soils are similar to the Renohill soils and differ mainly in lacking bedrock at a depth of less than 40 inches.

Abruptic Aridic Paleustolls.—The soils of this subgroup in Adams County formed under grassland vegetation in both eolian material and the pedisediments derived from the Rocky Mountain system. The average annual rainfall is 14 to 15 inches, the average annual soil temperature is about 52° F., and the average soil temperature in summer is about 72°. These soils are nearly level on tablelands or slightly concave on areas of the uplands.

Virgin soils of this subgroup have an A1, A2, B2t, B3ca, Cca horizon sequence. The A1 horizon is moderately thick, moderately dark colored, and noncalcareous. It is friable and has fine, granular structure.

Typically, the A1 horizon overlies a very thin and intermittent A2 horizon of much lighter color. This

horizon is entirely absent in many places or is indicated only by a graying on the surfaces of the granules in the lower part of the A1 horizon.

The B2t horizon is fine textured, is noncalcareous, and has strong, fine prismatic structure parting to strong, fine, angular blocky structure. The soil mass is slightly hard when dry and parts easily into the primary aggregates that are, in themselves, extremely hard when dry. Thick, continuous clay films are on the surfaces of most of the soil aggregates. This horizon typically is noncalcareous, but it is calcareous in the lower few inches in some places.

Below the B2t horizon typically is a transitional B3ca horizon that has retained most of the characteristics of the B2t horizon, but in which consistent accumulation of secondary calcium carbonate is present, principally as concretions.

The Cca horizon is coarser textured than the B2t horizon, is calcareous, and is massive. Texture varies with the type of parent sediment. This horizon contains continuous, distinct, and, in some places, strong accumulations of secondary calcium carbonate as concretions, thin seams or streaks, or finely divided forms.

This subgroup is represented in Adams County by the Weld and Platner series. The Weld series is considered representative of the subgroup.

The Platner soils have morphology similar to that of the Weld series. Soils of the two series differ primarily in the content of fine or coarser sand that they contain. The Weld soils formed in eolian sediments and have less than 15 percent fine sand or coarser, but the Platner soils have a much higher content of fine, medium, and coarse sand, as well as some gravel.

Aridic Argiustolls.—The soils of this subgroup in Adams County formed under grassland vegetation in a variety of parent materials. The average annual precipitation is 14 to 15 inches, the average annual soil temperature is about 52° F., and the average soil temperature in summer is about 72°. These soils are gently rolling or undulating on upland plains or on high terrace levels.

Virgin soils of this group typically have an A1, B1, B2t, B3ca, Cca horizon sequence. The A1 horizon typically is moderately thick, moderately dark in color, and noncalcareous. This horizon generally has granular structure and is friable.

These soils have a transitional B1 horizon below the A1 horizon that retains the color and organic-carbon content of the A1 horizon but that has structure similar to the B2t horizon and some evidence of accumulation of silicate clay.

The B2t horizon is typically moderately dark in the upper part and noncalcareous. It has moderate, medium, prismatic structure parting to subangular blocky structure. The soil mass is slightly hard to hard when dry, but individual aggregates are extremely hard when dry in places, depending upon their texture. This horizon typically is noncalcareous for most of its thickness, although in some areas it is weakly calcareous in the lower few inches.

Below the B2t horizon is generally a transitional B3ca horizon that has retained many of the characteristics of the B2t horizon but has visible accumulation of secondary calcium carbonate principally as concretions or thin seams and streaks.

The Cca horizon typically is coarser textured than the B2t horizon, is massive, and is calcareous. Most of these soils contain distinct and continuous horizons of secondary calcium carbonate accumulation ranging from moderate to strong, depending upon the individual series.

This subgroup is represented in Adams County by the Ascalon, Dacono, Nunn, Satanta, and Truckton series. The Ascalon series is representative of the subgroup.

The Satanta soils differ from the Ascalon soils principally in having a clay loam B2t horizon. The Dacono soils differ from the Ascalon soils in having a heavy clay loam or clay B2t horizon and in overlying a contrasting sandy skeletal substratum between depths of 20 and 40 inches. The Nunn soils differ from the Ascalon soils in having a texture of heavy clay loam or light clay and generally in containing less sand. The Truckton soils differ from the Ascalon soils in having a sandy loam Bt horizon.

Torriorthentic Haplustolls.—The soils of this subgroup in Adams County formed under grassland vegetation in areas of deep eolian sands derived principally from Dawson and Arapahoe arkose deposits. The average annual precipitation is about 14 inches, the average annual soil temperature is about 52° F., and the average soil temperature in summer is about 72°. These soils are moderately to steeply sloping on areas adjacent to stream channels draining the arkose areas. They commonly have a dunelike surface relief.

The virgin soils typically have an A, C horizon sequence. The A horizon is friable, moderately thick, and moderately dark colored. It has a coarse, granular structure and is slightly hard to soft when dry.

The C horizon is lighter colored, noncalcareous, and massive. It is dominantly coarse loamy sand or coarse sand. The C horizon is noncalcareous, and no secondary accumulation of calcium carbonate is present. Consistence ranges from hard to very hard when dry.

This subgroup is represented in Adams County by the Blakeland series. The Blakeland soils formed in eolian sand deposits blown out of river channels that drain the Denver and Arapahoe arkose beds. This particular series has a higher percentage of medium and coarse angular granite sand than is typic of this subgroup in other areas. In spite of the coarse texture, these soils have hard-setting properties when air dry, and the soil mass in horizons that have a low organic-matter content may be very hard when dry.

General Nature of the County

Adams County was created by the State Legislature on April 15, 1901, from a part of Arapahoe County. Homesteading and farming began in 1860 and expanded until nearly all of the county was cultivated, except for a few large ranches in the eastern part. The western part of the county is presently being taken over for community and industrial development, and is part of the expanding metropolitan area of Denver.

Adams County is entirely within the Colorado Piedmont section of the Great Plains physiographic provin

The county is drained by the South Platte River and its tributaries. Most of the county is characterized by broadly rolling topography, and the major streams generally are in relatively wide valleys. In the western part of the county, the larger stream valleys are from 250 to 300 feet below the general level of the nearby uplands, and the side slopes are moderately steep. Through most of the remaining part of the county, the local relief seldom exceeds 200 feet, and in many places the side slopes are so gradual that the limits of the valleys are scarcely noticeable. Several relatively large areas of stabilized dune topography are in the county, mainly in a broad area north of Sand Creek and along the valleys of Beebe Draw, and the Box Elder, Kiowa, and Bijou Creeks.

The farms in Adams County are slowly being consolidated into larger, more efficient units, utilizing the latest technology available. Where underground water resources support it, sprinkler irrigation on the sandy soils is increasing rapidly. The ranching operations remain about the same, but farming is diminishing rapidly in the western part of the county because of the industrial and community development.

Production of corn, alfalfa, and small grains is expected to remain fairly stable. The sugar beet industry is slowly decreasing. Truck crop farming is decreasing and becoming very specialized. Cattle feedlots and hog raising are decreasing and eventually will be eliminated in the western part of the county because of zoning ordinances. Ornamental specialty crops, greenhouses, and turf farms are increasing rapidly and are expected to continue to do so for some time to come. Poultry raising is dominated by large commercial enterprises and likely will continue to increase.

The supply of water for farming, especially in the western fourth of the county, is being competed for by the metropolitan and suburban areas, and a shortage of water is likely to become acute in the coming years.

Climate [9]

The climate of Adams County is that of the semiarid high plains. It is modified by the Rocky Mountains to the west and the higher country of the Black Forest area to the south. The effects of the mountains vary considerably with increasing distance from the western end of the county toward the east. The county, 72 miles long and 18 miles wide, ranges in elevation from 5,570 feet at the southwest corner to 4,500 feet at the northeast corner, and is within a plains climate that changes rapidly to a foothills climate just west of the county.

Many features of the climate at Denver, which is representative of the extreme western and southwestern part of Adams County, can be applied with some modification to the entire county. Variations in climate from the western border eastward include increased average windspeed because of the reduced effectiveness of mountain shielding, slightly lower average annual precipitation, lower amounts of precipitation and snowfall in winter and early in spring, increased amounts and variability of summer precipitation, greater average variation in daily and annual temperatures, and somewhat lower cloudiness and higher percentage of sunshine on an annual average. Table 9 gives climatic data compiled from records kept mainly at Byers, Arapahoe County,

[9] By JOSEPH W. BERRY, climatologist for Colorado, National Weather Service, U.S. Department of Commerce.

TABLE 9.—*Temperature and precipitation data*

[Data for temperature and precipitation from Byers, Arapahoe County. Data on snow cover from Stapleton Airfield at Denver]

Month	Temperature				Precipitation				
	Average daily maximum	Average daily minimum	2 years in 10 will have at least 4 days with— Maximum temperature equal to or higher than—	2 years in 10 will have at least 4 days with— Minimum temperature equal to or lower than—	Average total	2 years in 10 will have— Less than—	2 years in 10 will have— More than—	Average number of days with snow cover	Average depth of snow on days with snow cover
	°F.	°F.	°F.	°F.	Inches	Inches	Inches		Inches
January	43	14	61	−6	0.43	0.1	0.8	8	2
February	46	18	64	−2	.47	.2	.7	9	3
March	52	23	70	4	.87	.4	1.6	7	3
April	62	33	79	19	1.86	.7	2.8	3	4
May	71	42	86	32	2.54	.9	3.7	1	3
June	84	51	96	40	1.58	.7	2.6	0	0
July	91	57	99	50	2.01	1.0	3.2	0	0
August	89	56	98	49	1.49	.7	2.1	0	0
September	80	47	94	35	1.14	.2	1.7	(1)	4
October	69	36	83	25	.72	.1	1.5	1	2
November	54	23	71	7	.54	.2	.9	5	3
December	46	18	64	2	.40	.1	.6	7	3
Year	66	35	[2] 101	[3] −14	14.05	9.2	18.3	41	3

[1] Less than one-half day.
[2] Average annual highest temperature.
[3] Average lowest annual temperature.

Colorado. These data are representative of most of Adams County.

The average annual temperature is near 50° at an elevation of 5,200 feet, but this can be expected to vary a few degrees from the lower elevations at the eastern end of the county to the higher elevations at the western end. The wide average range in daily temperature of 25° to 35° and a wide average range in annual temperature are typical of the High Plains. As a result of wide variations from day to day or over a period of a few days, extremely hot weather in summer or extremely cold weather in winter is generally of short duration and is followed by more moderate temperature.

The average annual growing season in Adams County is about 150 days. Table 10 gives the probability at Byers, Arapahoe County, of the last freezing temperatures in spring and the first freezing temperatures in fall.

Data for long periods indicate that the average annual precipitation in the county ranges from 12.5 to 14.5 inches. It tends to be higher in the western part. Variations within the county are related to the local terrain, elevation, and slope. Particularly in spring and summer, the extreme variability in the amount of precipitation from year to year and between localities in the same year is so large that even long-period averages are affected by chance occurrences and are not easily interpreted in terms of actual climatic differences. Probable annual precipitation (fig. 19) is particularly significant in showing the expected variation of rainfall from year to year.

When annual precipitation for 2 years in a row is less than about 11 inches, most dryland crops fail. Two or more dry years in a row generally do not occur more than once every 10 years. Figures on the normal average temperature and precipitation by months and year, along with days of snow cover, are given in table 9.

Total precipitation and snowfall in winter are higher in the western part of the county than in the eastern part. Differences are sometimes small but consistent from October into May. The average annual snowfall is about 59 inches at Denver and is about 46 inches at Byers. In summer, however, precipitation generally averages somewhat higher in the eastern part of the county but is highly variable from year to year at different localities.

The average relative humidity is 39 percent through the day and 62 percent during the night. It is slightly higher in winter than in summer. On the average, the sun shines 69 percent of the possible hours of sunlight annually.

Hailstorms that are damaging to crops occur in some parts of the county almost every year. There is no extended pattern to the hailstorms. They generally occur between May 15 and September 1, and they are most likely to occur in June and July. The hail generally falls in strips less than 1 mile wide and 6 miles long. Hail is more common in the eastern part of the county than in the western part.

Literature Cited

(1) American Association of State Highway Officials.
1961. Standard specifications for highway materials and methods of sampling and testing. Ed. 8, 2 v., illus. Washington, D.C.

(2) Baldwin, Mark, Kellogg, Charles E., and Thorp, James.
1938. Soil classification. U.S. Dept. Agr. Ybk.: 978–1001, illus.

(3) Simonson, Roy W.
1962. Soil classification in the United States. Sci. 137: 1027–1034.

(4) Thorp, James and Smith, Guy D.
1949. Higher categories of soil classification: order, suborder, and great soil groups. Soil Sci. 67: 117–126.

(5) United States Department of Agriculture.
1951. Soil survey manual. Agr. Handbook 18. 503, pp., illus. [Supplement issued in May 1962]

(6) ———
1960. Soil classification, a comprehensive system, 7th approximation. 265 pp., illus. [Supplements issued in March 1967 and September 1968]

(7) United States Department of Defense.
1968. Unified soil classification system for roads, a fields, embankments, and foundations. MIL–STD–619B. 30 pp., illus.

Glossary

Aggregate, soil. Many fine particles held in a single mass or cluster. Natural soil aggregates such as crumbs, blocks, or prisms, are called peds. Clods are aggregates produced by tillage or logging.

Alkali soil. Generally, a highly alkaline soil. Specifically, an alkali soil has so high a degree of alkalinity (pH 8.5 or higher) or so high a percentage of exchangeable sodium (15 percent or more of the total exchangable bases), or both, that the growth of most crop plants is low from this cause.

Table 10.—*Probable dates of last freezing temperatures in spring and first in fall*

[Based on data from Byers, Arapahoe County]

Probability	Dates for a given probability at a temperature of—				
	16° F. or lower	20° F. or lower	24° F. or lower	28° F. or lower	32° F. or lower
Spring:					
1 year in 10 later than	April 17	April 23	May 4	May 13	May 29.
2 years in 10 later than	April 11	April 18	April 28	May 7	May 23.
5 years in 10 later than	March 31	April 7	April 17	April 27	May 11.
Fall:					
1 year in 10 earlier than	October 24	October 14	October 3	September 25	September 13.
2 years in 10 earlier than	October 29	October 19	October 8	September 30	September 18.
5 years in 10 earlier than	November 8	October 29	October 13	October 10	September 29.

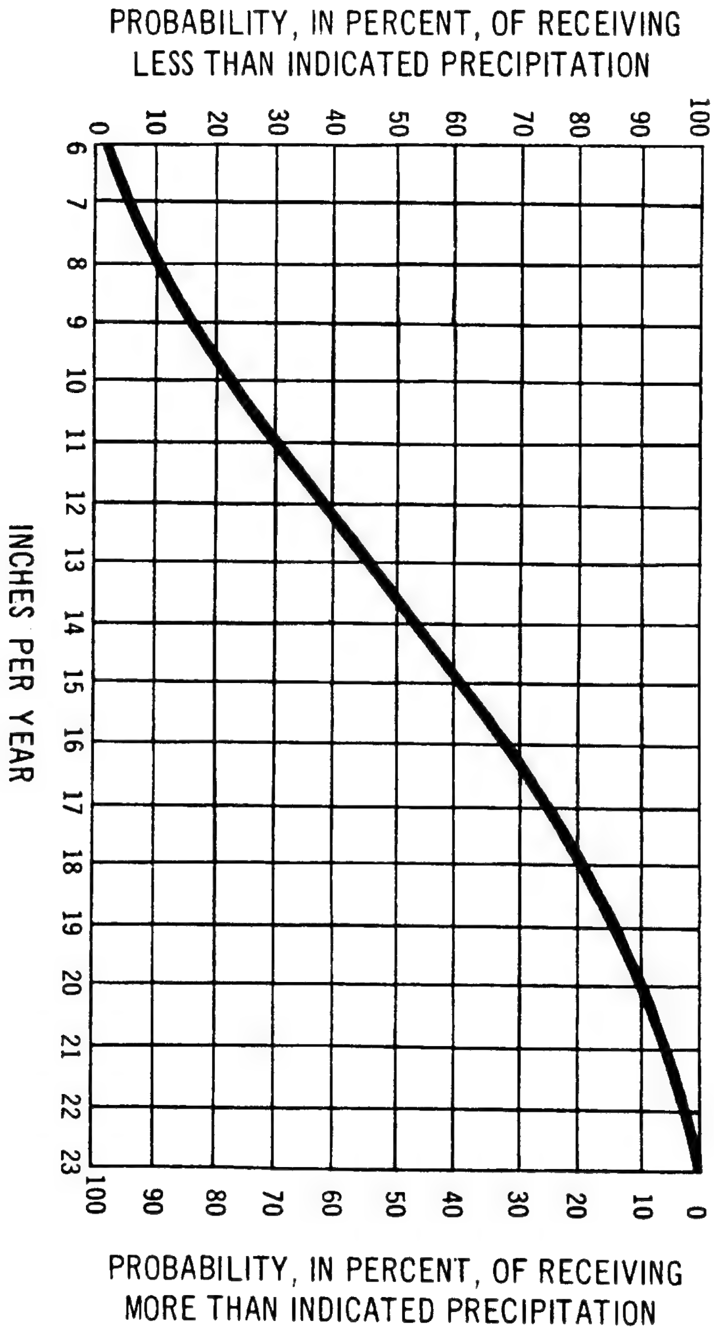

Figure 19.—**Probability, in percent, of receiving less and more than specified amounts of annual precipitation at Byers, Arapahoe County.**

Alluvium. Soil material, such as sand, silt, or clay, that has been deposited on land by streams.

Available water capacity (also termed available moisture capacity). The capacity of soils to hold water available for use by most plants. It is commonly defined as the difference between the amount of soil water at field capacity and the amount at wilting point. It is commonly expressed as inches of water per inch of soil.

Calcareous soil. A soil containing enough calcium carbonate (often with magnesium carbonate) to effervesce (fizz) visibly when treated with cold, dilute hydrochloric acid.

Chiseling. Tillage of soil with an implement having one or more soil penetrating points that loosen the subsoil and brings *clods* to the surface. A form of emerging tillage to control soil blowing.

Clay. As a soil separate, the mineral soil particles less than 0.002 millimeter in diameter. As a soil textural class, soil material that is 40 percent or more clay, less than 45 percent sand, and less than 40 percent silt.

Clay film. A thin coating of clay on the surface of a soil aggregate. Synonyms: clay coat, clay skin.

Colluvium. Soil material, rock fragments, or both, moved by creep, slide, or local wash and deposited at the base of steep slopes.

Concretions. Grains, pellets, or nodules of various sizes, shapes, and colors consisting of concentrations of compounds, or of soil grains cemented together. The composition of some concretions is unlike that of the surrounding soil. Calcium carbonate and iron oxide are examples of material commonly found in concretions.

Consistence, soil. The feel of the soil and the ease with which a lump can be crushed by the fingers. Terms commonly used to describe consistence are—

Loose.—Noncoherent when dry or moist; does not hold together in a mass.

Friable.—When moist, crushes under moderate pressure between thumb and forefinger and can be pressed together into a lump.

Firm.—When moist, crushes under moderate pressure between thumb and forefinger, but resistance is distinctly noticeable.

Plastic.—When wet, readily deformed by moderate pressure but can be pressed into a lump; will form a "wire" when rolled between thumb and forefinger.

Sticky.—When wet, adheres to other material, and tends to stretch somewhat and pull apart, rather than to pull free from other material.

Hard.—When dry, moderately resistant to pressure; can be broken with difficulty between thumb and forefinger.

Soft.—When dry, breaks into powder or individual grains under very slight pressure.

Cemented.—Hard and brittle; little affected by moistening.

Dryfarming. Production of crops that require some tillage in a subhumid or semiarid region, without irrigation. Usually involves use of periods of fallow, during which time enough moisture accumulates in the soil to allow production of a cultivated crop.

Duff. The matted, partly decomposed organic surface layer on forested soils.

Dune. A mound or ridge of loose sand piled up by the wind.

Fallow. Cropland left idle in order to restore productivity, mainly through accumulation of water, nutrients, or both. Summer fallow is a common stage before cereal grain in regions of limited rainfall. The soil is tilled for at least one growing season to control weeds, to aid decomposition of plant residues, and to encourage the storage of moisture for the succeeding grain crop.

Gravelly soil material. From 15 to 50 percent of material, by volume, consists of rounded or angular rock fragments that are not prominently flattened and are up to 3 inches in diameter.

Horizon, soil. A layer of soil, approximately parallel to the surface, that has distinct characteristics produced by soil-forming processes. These are the major horizons:

O horizon.—The layer of organic matter on the surface of a mineral soil. This layer consists of decaying plant residues.

A horizon.—The mineral horizon at the surface or just below an O horizon. This horizon is the one in which living organisms are most active and therefore is marked by the accumulation of humus. The horizon may have lost one or more of soluble salts, clay, and sesquioxides (iron and aluminum oxides).

B horizon.—The mineral horizon below an A horizon. The B horizon is in part a layer of change from the overlying A to the underlying C horizon. The B horizon also has distinctive characteristics caused (1) by accumulation of clay, sesquioxides, humus, or some combination of these; (2) by prismatic or blocky structure; (3) by redder or stronger colors than the A horizon; or (4) by some combination of these. Combined A and B horizons are usually called the solum, or true soil. If a soil lacks a B horizon, the A horizon alone is the solum.

C horizon.—The weathered rock material immediately beneath the solum. In most soils this material is presumed to be

like that from which the overlying horizons were formed. If the material is known to be different from that in the solum, a Roman numeral precedes the letter C.

R layer.—Consolidated rock beneath the soil. The rock usually underlies a C horizon but may be immediately beneath an A or B horizon.

Listing. A method of tillage in which the plowshares throw the soil in opposite directions and leave the field with alternate ridges and furrows. Used to roughen the surface for protection against soil blowing.

Loess. Fine-grained material, dominantly of silt-sized particles, that has been deposited by wind.

Parent material. Disintegrated and partly weathered rock from which soil has formed.

Ped. An individual natural soil aggregate, such as a crumb, a prism, or a block, in contrast to a clod.

Pedisediments. A layer of translocated, till-like sediment covering an erosion surface (pedisediment) at the foot of a receded slope that is underlain by rocks or sediments of the upland.

Profile, soil. A vertical section of the soil through all its horizons and extending into the parent material.

Permeability. The quality that enables the soil to transmit water or air. Terms used to describe permeability are as follows: *very slow, slow, moderately slow, moderate, moderately rapid, rapid,* and *very rapid.*

Plow layer. The soil ordinarily moved in tillage; equivalent to surface soil.

Reaction, soil. The degree of acidity or alkalinity of a soil, expressed in pH values. A soil that tests to pH 7.0 is precisely neutral in reaction because it is neither acid nor alkaline. An acid, or "sour" soil is one that gives an acid reaction; an alkaline soil is one that is alkaline in reaction. In words, the degrees of acidity or alkalinity are expressed thus:

	pH		*pH*
Extremely acid	Below 4.5	Neutral	6.6 to 7.3
Very strongly acid	4.5 to 5.0	Mildly alkaline	7.4 to 7.8
Strongly acid	5.1 to 5.5	Moderately alkaline	7.9 to 8.4
Medium acid	5.6 to 6.0	Strongly alkaline	8.5 to 9.0
Slightly acid	6.1 to 6.5	Very strongly alkaline	9.1 and higher

Relief. The elevations or inequalities of a land surface, considered collectively.

Runoff (hydraulics). The part of the precipitation upon a drainage area that is discharged from the area in stream channels. The water that flows off the land surface without sinking in is called surface runoff; that which enters the ground before reaching surface streams is called ground-water runoff or seepage flow from ground water.

Sand. Individual rock or mineral fragments in a soil that range in diameter from 0.05 to 2.0 millimeters. Most sand grains consist of quartz, but they may be of any mineral composition. The textural class name of any soil that contains 85 percent or more sand and not more than 10 percent clay.

Silt. Individual mineral particles in a soil that range in diameter from the upper limit of clay (0.002 millimeter) to the lower limit of very fine sand (0.05 millimeter). Soil of the silt textural class is 80 percent or more silt and less than 12 percent clay.

Slickspots. Small areas in a field that are slick when wet because they contain excess exchangeable sodium, or alkali.

Soil. A natural, three-dimensional body on the earth's surface that supports plants and that has properties resulting from the integrated effect of climate and living matter acting on earthy parent material, as conditioned by relief over periods of time.

Solum. The upper part of a soil profile, above the parent material, in which the processes of soil formation are active. The solum in mature soil includes the A and B horizons. Generally, the characteristics of the material in these horizons are unlike those of the underlying material. The living roots and other plant and animal life characteristic of the soil are largely confined to the solum.

Structure, soil. The arrangement of primary soil particles into compound particles or clusters that are separated from adjoining aggregates and have properties unlike those of an equal mass of unaggregated primary soil particles. The principal forms of soil structure are—*platy* (laminated), *prismatic* (vertical axis of aggregates longer than horizontal), *columnar* (prisms with rounded tops), *blocky* (angular or subangular), and *granular*. *Structureless* soils are (1) *single grain* (each grain by itself, as in dune sand) or (2) *massive* (the particles adhering together without any regular cleavage, as in many claypans and hardpans).

Stubble mulch. Stubble or other crop residues left on the soil, or partly worked into the soil, to provide protection from wind and water erosion after harvest, during preparation of a seedbed for the next crop, and during the early growing period of the new crop.

Subsoil. Technically, the B horizon; roughly, the part of the solum below plow depth.

Substratum. Technically, the part of the soil below the solum.

Surface layer. A term used in nontechnical soil descriptions for one or more layers above the subsoil. Includes A horizon and part of the B horizon; has no depth limit.

Terrace. An embankment, or ridge, constructed across sloping soils on the contour or at a slight angle to the contour. The terrace intercepts surplus runoff so that it may soak into the soil or flow slowly to a prepared outlet without harm. Terraces in fields are generally built so they can be farmed. Terraces intended mainly for drainage have a deep channel that is maintained in permanent sod.

Terrace (geological). An old alluvial plain, ordinarily flat or undulating, bordering a river, lake, or the sea. Stream terraces are frequently called second bottoms, as contrasted to flood plains, and are seldom subject to overflow. Marine terraces were deposited by the sea and are generally wide.

Texture, soil. The relative proportions of sand, silt, and clay particles in a mass of soil. The basic textural classes, in order of increasing proportions of fine particles, are *sand, loamy sand, sandy loam, loam, silt loam, silt, sandy clay loam, clay loam, silty clay loam, sandy clay, silty clay,* and *clay.* The sand, loamy sand, and sandy loam classes may be further divided by specifying "coarse," "fine," or "very fine."

Tillage pan. A dense, highly compact soil zone occurring just below normal tillage depth; caused by tilling when the soil is too wet.

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For a full description of a mapping unit, read both the description of the mapping unit and that of the soil series section it is in for general information about its management. For information on the use and management of soil

Acreage and extent, table 1, p. 8.
Predicted yields, tables 2 and 3, pp. 31 and 32.

Map symbol	Mapping unit	Page	Capability unit: Irrigated Symbol	Irrigated Page	Nonirrigated Symbol	Nonirrigated Page	Range site Name	Range site Page	Tree planting suitability group Number
AaB	Adena loam, 0 to 3 percent slopes----------	9	------	--	IVe-3	36	Loamy Plains	41	1
AaC	Adena loam, 3 to 5 percent slopes----------	9	------	--	IVe-4	37	Loamy Plains	41	1
AcC	Adena-Colby association, gently sloping----	9	------	--	IVe-4	37	Loamy Plains	41	1
AcD	Adena-Colby association, moderately sloping----------------------------------	9	------	--	VIe-1	38	Loamy Plains	41	1
AdB	Arvada loam, 0 to 3 percent slopes---------	10	------	--	VIIs-2	39	Salt Flat	43	4
ArB	Ascalon loamy sand, 0 to 3 percent slopes--	11	IIIe-5	34	IVe-9	37	Sandy Plains	42	2
ArC	Ascalon loamy sand, 3 to 5 percent slopes--	11	------	--	IVe-7	37	Sandy Plains	42	2
AsB	Ascalon sandy loam, 1 to 3 percent slopes--	11	IIe-2	32	IIIe-7	36	Sandy Plains	42	2
AsC	Ascalon sandy loam, 3 to 5 percent slopes--	11	IIIe-3	33	IVe-7	37	Sandy Plains	42	2
AsD	Ascalon sandy loam, 5 to 9 percent slopes--	11	IVe-2	35	IVe-6	37	Sandy Plains	42	2
At	Ascalon-Platner association----------------	11							
	Ascalon soil--------------------------	--	------	--	IVe-7	37	Sandy Plains	42	2
	Platner soil--------------------------	--	------	--	IIIc-1	36	Loamy Plains	41	1
AvC	Ascalon-Vona sandy loams, 1 to 5 percent slopes---------------------------------	11	------	--	IVe-7	37	Sandy Plains	42	2
BoD	Blakeland loamy sand, 3 to 9 percent slopes---------------------------------	12	------	--	VIe-5	39	Deep Sand	42	3
Bt	Blakeland-Truckton association-------------	12	------	--	VIe-5	39	Deep Sand	42	3
CbE	Colby loam, 5 to 20 percent slopes---------	12	------	--	VIe-2	38	Loamy Slopes	41	1
DaA	Dacono loam, 0 to 1 percent slopes---------	13	IIIs-2	34	------	--	------------	--	1
DaB	Dacono loam, 1 to 3 percent slopes---------	13	IIIe-2	33	------	--	------------	--	1
Gr	Gravelly land-Shale outcrop complex--------	14							
	Gravelly land-------------------------	--	------	--	VIIs-5	40	Gravelly Breaks	43	4
	Shale outcrop-------------------------	--	------	--	VIIs-5	40	Shale Breaks	42	4
Gu	Gullied land-------------------------------	14	------	--	VIIe-1	39	------------	--	4
HlB	Heldt clay, 0 to 3 percent slopes----------	15	IIIs-1	34	IVs-3	38	Clayey Plains	42	4
HlD	Heldt clay, 3 to 9 percent slopes----------	15	IVe-1	35	VIe-3	38	Clayey Plains	42	4
Lu	Loamy alluvial land------------------------	15	------	--	VIe-1	38	Overflow	43	5
Lv	Loamy alluvial land, gravelly substratum---	16	IVw-1	35	------	--	------------	--	5
Lw	Loamy alluvial land, moderately wet--------	16	IIIw-1	35	------	--	------------	--	5
NlA	Nunn loam, 0 to 1 percent slopes-----------	17	I-1	31	------	--	------------	--	1
NlB	Nunn loam, 1 to 3 percent slopes-----------	17	IIe-1	32	IIIc-1	36	Loamy Plains	41	1
NuA	Nunn clay loam, 0 to 1 percent slopes------	17	IIs-1	33	------	--	------------	--	1
NuB	Nunn clay loam, 1 to 3 percent slopes------	17	IIe-1	32	IIIs-3	36	Clayey Plains	42	1
PlB	Platner loam, 0 to 3 percent slopes--------	18	IIe-1	32	IIIc-1	36	Loamy Plains	41	1
PlC	Platner loam, 3 to 5 percent slopes--------	18	IIIe-1	33	IIIe-6	36	Loamy Plains	41	1
ReB	Renohill loam, 1 to 3 percent slopes-------	18	------	--	IVe-3	36	Loamy Plains	41	3
ReD	Renohill loam, 3 to 9 percent slopes-------	18	IVe-1	35	VIe-1	38	Loamy Plains	41	3
Ro	Rough broken land--------------------------	18	------	--	VIIs-1	39	Sandstone Breaks	42	4
SaE	Samsil clay, 3 to 20 percent slopes--------	19	------	--	VIIe-6	39	Shale Breaks	42	4
ShF	Samsil-Shingle complex, 3 to 35 percent slopes----------------------------------	19							
	Samsil soil---------------------------	--	------	--	VIIe-6	39	Shale Breaks	42	4
	Shingle soil--------------------------	--	------	--	VIIe-6	39	Loamy Slopes	41	4

IDE TO MAPPING UNITS

il series to which the mapping unit belongs. In referring to a capability unit or a range site, read the introductio
t of soils for trees and shrubs, see the section beginning on page 44. Other information is given in tables as follows.

Engineering uses of soils, tables 6 and 7, pp. 48 through 59.

ting
ity

Map symbol	Mapping unit	Page	Capability unit Irrigated Symbol	Page	Capability unit Nonirrigated Symbol	Page	Range site Name	Page	Tree planting suitability group Number
Sm	Sandy alluvial land------------------------	20	------	--	VIIw-1	39	------------	--	4
SnA	Satanta loam, 0 to 1 percent slopes---------	20	I-1	31	------	--	------------	--	1
SnB	Satanta loam, 1 to 3 percent slopes---------	20	IIe-1	32	IIIc-1	36	Loamy Plains	41	1
SrE	Shingle-Renohill loams, 5 to 25 percent slopes----------------------------------	21	------	--	VIe-2	38	Loamy Slopes	41	4
StB	Stoneham loam, 0 to 3 percent slopes--------	22	------	--	IVe-3	36	Loamy Plains	41	1
StD	Stoneham loam, 3 to 9 percent slopes--------	22	------	--	VIe-1	38	Loamy Plains	41	1
Tc	Terrace escarpments-----------------------	22	------	--	VIIe-3	39	Gravel Breaks	43	4
TeB	Terry fine sandy loam, 0 to 3 percent slopes----------------------------------	23	------	--	IVe-5	37	Sandy Plains	42	3
TeD	Terry fine sandy loam, 3 to 9 percent slopes----------------------------------	23	------	--	VIe-4	38	Sandy Plains	42	3
TrE	Terry-Tassel-Ulm complex, 3 to 20 percent slopes----------------------------------	23							
	Terry soil----------------------------	--	------	--	VIe-4	38	Sandy Plains	42	3
	Tassel soil----------------------------	--	------	--	VIe-4	38	Sandy Plains	42	3
	Ulm soil------------------------------	--	------	--	VIe-4	38	Loamy Plains	41	3
TsE	Terry-Vona-Tassell complex, 3 to 20 percent slopes----------------------------------	24	------	--	VIe-4	38	Sandy Plains	42	3
TtB	Truckton loamy sand, 0 to 3 percent slopes----------------------------------	24	IIIe-5	34	IVe-9	37	Sandy Plains	42	2
TtD	Truckton loamy sand, 3 to 9 percent slopes----------------------------------	24	------	--	VIe-4	38	Sandy Plains	42	2
TuB	Truckton sandy loam, 1 to 3 percent slopes----------------------------------	24	IIIe-4	34	IIIe-7	36	Sandy Plains	42	2
TuC	Truckton sandy loam, 3 to 5 percent slopes----------------------------------	25	IIIe-3	33	------	--	------------	--	2
TuD	Truckton sandy loam, 3 to 9 percent slopes----------------------------------	25	------	--	VIe-4	38	Sandy Plains	42	2
UlB	Ulm loam, 1 to 3 percent slopes------------	26	------	--	IVe-3	36	Loamy Plains	41	1
UlC	Ulm loam, 3 to 5 percent slopes------------	26	IIIe-1	33	IVe-4	37	Loamy Plains	41	1
UlD	Ulm loam, 5 to 9 percent slopes------------	26	IVe-1	35	VIe-1	38	Loamy Plains	41	1
VaD	Valent loamy sand, 1 to 9 percent slopes----	26	------	--	VIe-5	39	Deep Sand	42	3
VnB	Vona loamy sand, 0 to 3 percent slopes------	27	IIIe-5	34	IVe-8	37	Sandy Plains	42	2
VnD	Vona loamy sand, 3 to 9 percent slopes------	27	------	--	VIe-4	38	Sandy Plains	42	2
VoA	Vona sandy loam, 0 to 1 percent slopes------	27	IIs-2	33	------	--	------------	--	2
VoB	Vona sandy loam, 1 to 3 percent slopes------	27	IIIe-4	34	IVe-5	37	Sandy Plains	42	2
VoC	Vona sandy loam, 3 to 5 percent slopes------	28	IIIe-3	33	------	--	------------	--	2
VsD	Vona-Ascalon loamy sands, 3 to 9 percent slopes----------------------------------	28	------	--	VIe-4	38	Sandy Plains	42	2
WmB	Weld loam, 1 to 3 percent slopes-----------	28	IIe-1	32	IIIc-1	36	Loamy Plains	41	1
WrB	Weld-Deertrail complex, 0 to 3 percent slopes----------------------------------	28							
	Weld soil-----------------------------	--	------	--	IVs-2	38	Loamy Plains	41	3
	Deertrail soil------------------------	--	------	--	IVs-2	38	Alkaline Plains	43	3
Wt	Wet alluvial land--------------------------	29	Vw-1	35	------	--	Wet Meadow	43	4
WuE	Wiley-Adena-Renohill complex, 3 to 20 percent slopes--------------------------	29	------	--	VIe-1	38	Loamy Slopes	41	3

CONVENTIONAL SIGNS

WORKS AND STRUCTURES

Highways and roads
- Divided
- Good motor
- Poor motor
- Trail

Highway markers
- National Interstate
- U. S.
- State or county

Railroads
- Single track
- Multiple track
- Abandoned

Bridges and crossings
- Road
- Trail
- Railroad
- Ferry (FY)
- Ford (FORD)
- Grade
- R. R. over
- R. R. under

Buildings
- School
- Church

Mine and quarry

Gravel pit

Power line

Spreader dam

Cemetery

Dams

Levee

Tanks

Well, oil or gas

Forest fire or lookout station

Windmill

Located object

BOUNDARIES

National or state

County

Minor civil division

Reservation

Land grant

Small park, cemetery, airport

Land survey division corners

DRAINAGE

Streams, double-line
- Perennial
- Intermittent

Streams, single-line
- Perennial
- Intermittent
  - Unclassified

Canals and ditches

Lakes and ponds
- Perennial (water, w)
- Intermittent (int)

Spring

Marsh or swamp

Wet spot

Drainage end or alluvial fan

Well, irrigation

Well, artesian

RELIEF

Escarpments
- Bedrock
- Other

Short steep slope

Prominent peak

Depressions (Large, Small)
- Crossable with tillage implements
- Not crossable with tillage implements
- Contains water most of the time

SOIL SURVEY DATA

Soil boundary
- and symbol

Gravel

Stoniness
- Stony
- Very stony

Rock outcrops

Chert fragments

Clay spot

Sand spot

Gumbo or scabby spot

Made land

Severely eroded spot

Blowout, wind erosion

Gully

Land fill

Saline spot

. SURVEY DATA

SOIL LEGEND

The first capital letter is the initial one of the soil name. A second capital letter, A, B, C, D, E, or F, shows the slope. Most symbols without a slope letter are those of soils or land types that have a considerable range of slope but some are for land types that are nearly level.

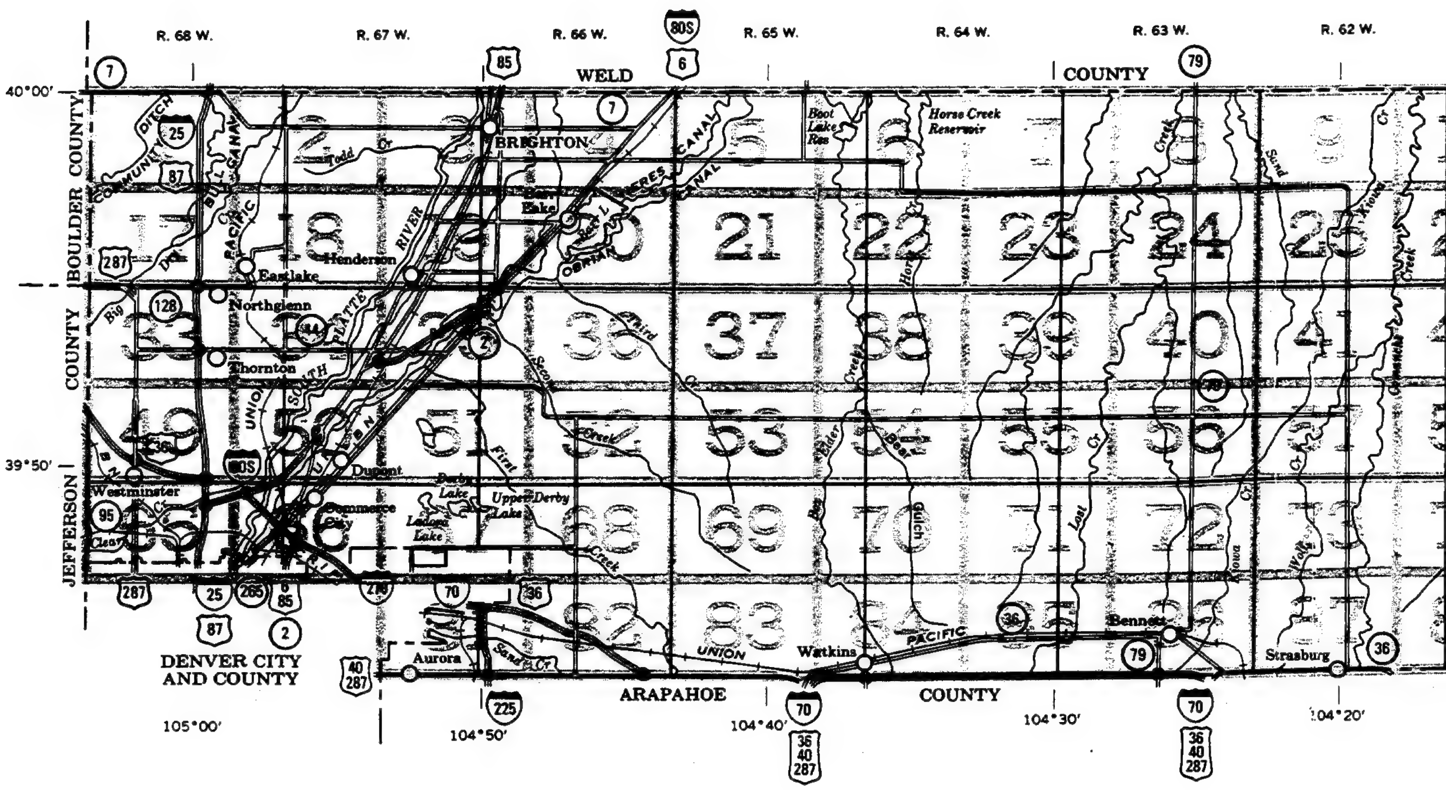
SYMBOL	NAME
AaB	Adena loam, 0 to 3 percent slopes
AaC	Adena loam, 3 to 5 percent slopes
AcC	Adena-Colby association, gently sloping
AcD	Adena-Colby association, moderately sloping
AdB	Arvada loam, 0 to 3 percent slopes
ArB	Ascalon loamy sand, 0 to 3 percent slopes
ArC	Ascalon loamy sand, 3 to 5 percent slopes
AsB	Ascalon sandy loam, 1 to 3 percent slopes
AsC	Ascalon sandy loam, 3 to 5 percent slopes
AsD	Ascalon sandy loam, 5 to 9 percent slopes
At	Ascalon-Platner association
AvC	Ascalon-Vona sandy loams, 1 to 5 percent slopes
BoD	Blakeland loamy sand, 3 to 9 percent slopes
Bt	Blakeland-Truckton association
CbE	Colby loam, 5 to 20 percent slopes
DaA	Dacono loam, 0 to 1 percent slopes
DaB	Dacono loam, 1 to 3 percent slopes
Gr	Gravelly land-Shale outcrop complex
Gu	Gullied land
HlB	Heldt clay, 0 to 3 percent slopes
HlD	Heldt clay, 3 to 9 percent slopes
Lu	Loamy alluvial land
Lv	Loamy alluvial land, gravelly substratum
Lw	Loamy alluvial land, moderately wet
NlA	Nunn loam, 0 to 1 percent slopes
NlB	Nunn loam, 1 to 3 percent slopes
NuA	Nunn clay loam, 0 to 1 percent slopes
NuB	Nunn clay loam, 1 to 3 percent slopes
PlB	Platner loam, 0 to 3 percent slopes
PlC	Platner loam, 3 to 5 percent slopes
ReB	Renohill loam, 1 to 3 percent slopes
ReD	Renohill loam, 3 to 9 percent slopes
Ro	Rough broken land
SaE	Samsil clay, 3 to 20 percent slopes
ShF	Samsil-Shingle complex, 3 to 35 percent slopes
Sm	Sandy alluvial land
SnA	Satanta loam, 0 to 1 percent slopes
SnB	Satanta loam, 1 to 3 percent slopes
SrE	Shingle-Renohill loams, 5 to 25 percent slopes
StB	Stoneham loam, 0 to 3 percent slopes
StD	Stoneham loam, 3 to 9 percent slopes
Tc	Terrace escarpments
TeB	Terry fine sandy loam, 0 to 3 percent slopes
TeD	Terry fine sandy loam, 3 to 9 percent slopes
TrE	Terry-Tassel-Ulm complex, 3 to 20 percent slopes
TsE	Terry-Vona-Tassel complex, 3 to 20 percent slopes
TtB	Truckton loamy sand, 0 to 3 percent slopes
TtD	Truckton loamy sand, 3 to 9 percent slopes
TuB	Truckton sandy loam, 1 to 3 percent slopes
TuC	Truckton sandy loam, 3 to 5 percent slopes
TuD	Truckton sandy loam, 3 to 9 percent slopes
UlB	Ulm loam, 1 to 3 percent slopes
UlC	Ulm loam, 3 to 5 percent slopes
UlD	Ulm loam, 5 to 9 percent slopes
VaD	Valent loamy sand, 1 to 9 percent slopes
VnB	Vona loamy sand, 0 to 3 percent slopes
VnD	Vona loamy sand, 3 to 9 percent slopes
VoA	Vona sandy loam, 0 to 1 percent slopes
VoB	Vona sandy loam, 1 to 3 percent slopes
VoC	Vona sandy loam, 3 to 5 percent slopes
VsD	Vona-Ascalon loamy sands, 3 to 9 percent slopes
WmB	Weld loam, 1 to 3 percent slopes
WrB	Weld-Deertrail complex, 0 to 3 percent slopes
Wt	Wet alluvial land
WuE	Wiley-Adena-Renohill complex, 3 to 20 percent slopes

INDEX TO MAP SHE

ADAMS COUNTY, COLORA

Scale 1:190,080

1 0 1 2 3 4 Mi

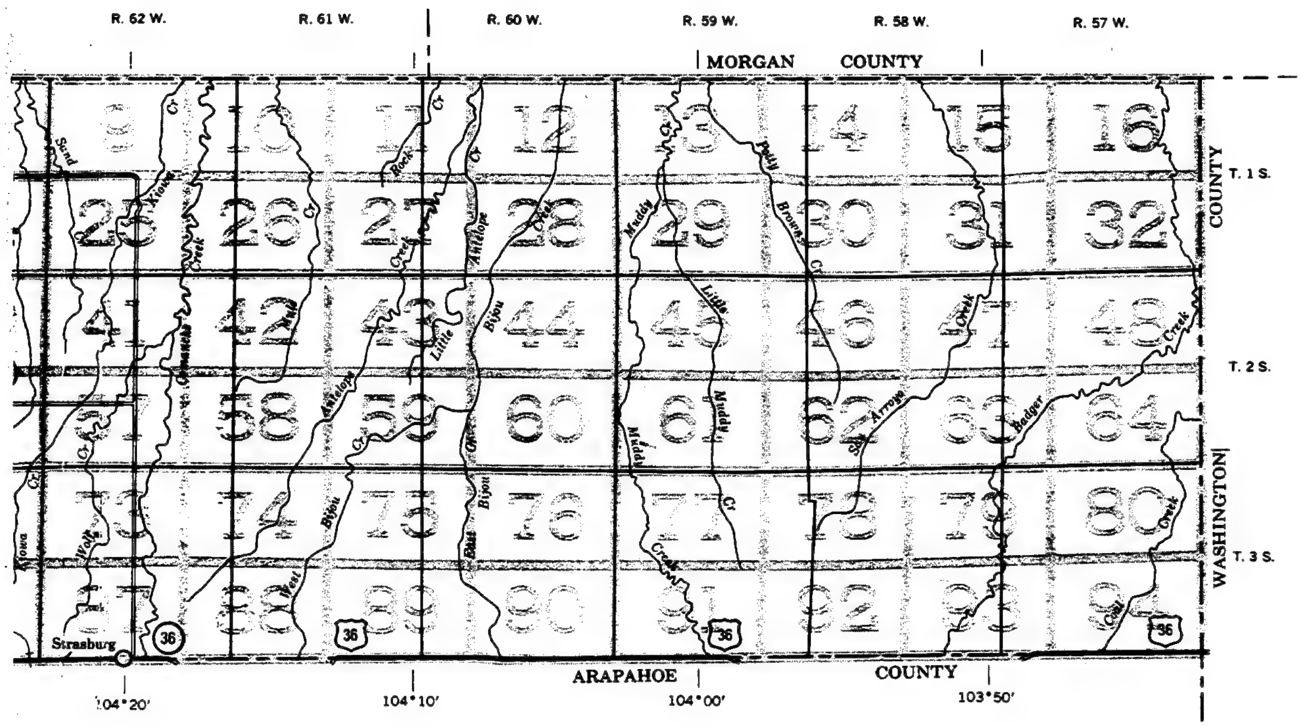


MAP SHEETS

NTY, COLORADO

le 1:190,080

1 2 3 4 Miles



INDEX TO MA

ADAMS COUNTY, (

Scale 1:190,08

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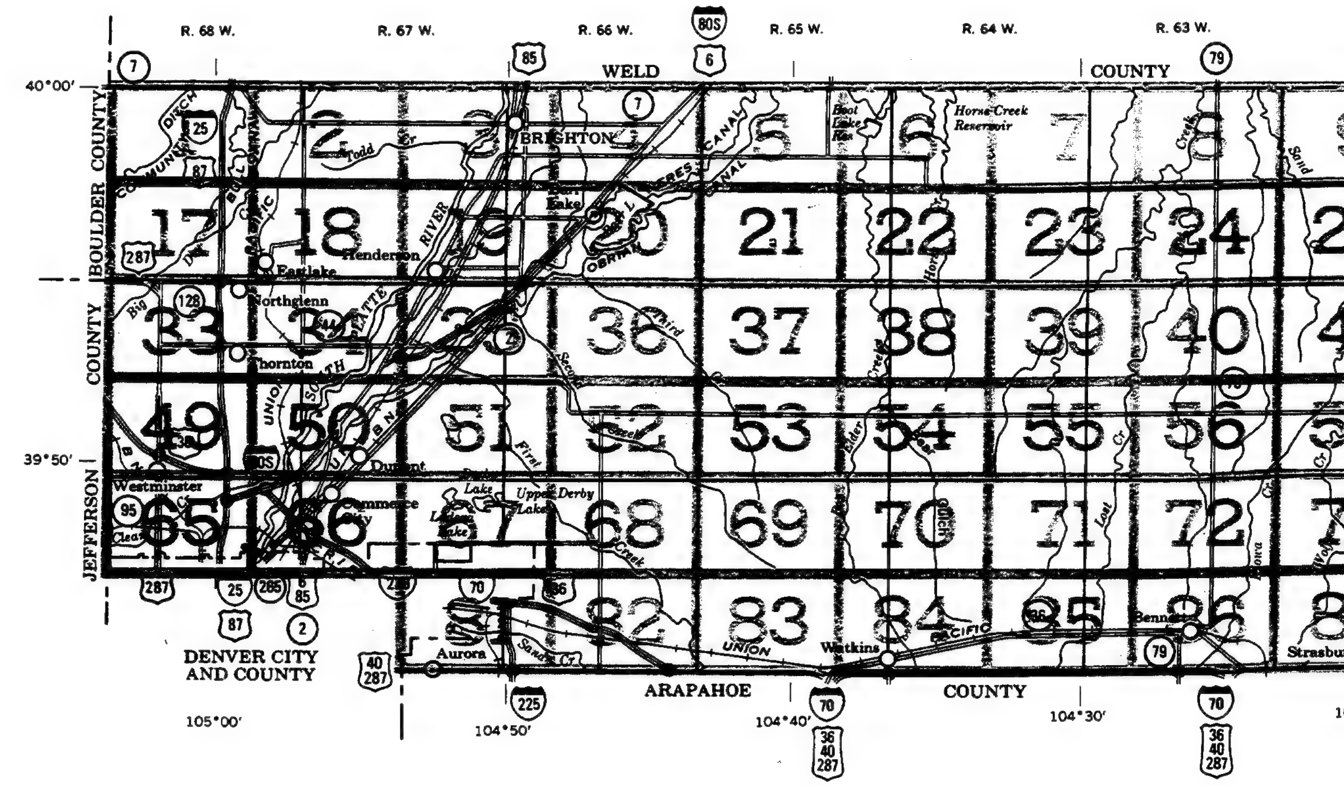


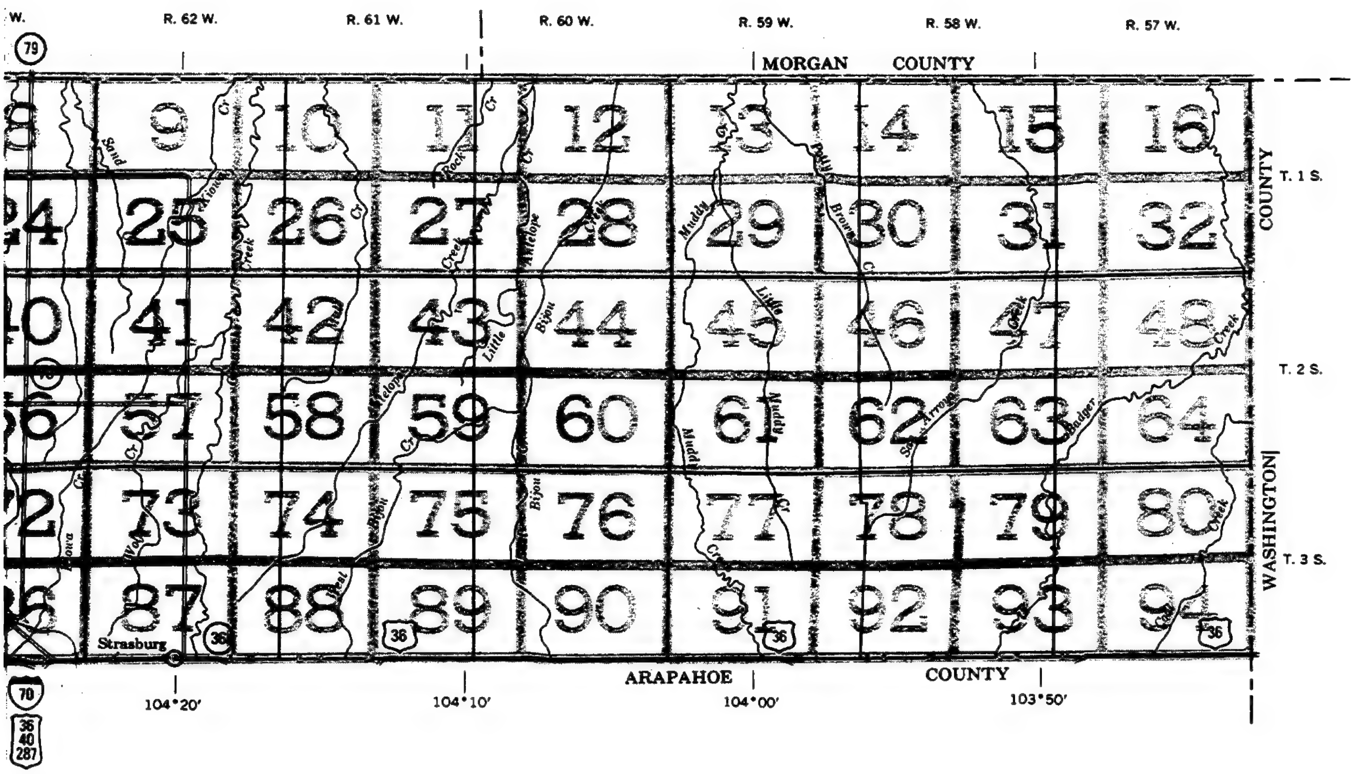
TO MAP SHEETS

COUNTY, COLORADO

Scale 1:190,080

0 1 2 3 4 Miles

N



SOIL LEGEND

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DaA	Dacono loam, 0 to 1 percent slopes
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HlD	Heldt clay, 3 to 9 percent slopes
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Lv	Loamy alluvial land, gravelly substratum
Lw	Loamy alluvial land, moderately wet
NlA	Nunn loam, 0 to 1 percent slopes
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NuA	Nunn clay loam, 0 to 1 percent slopes
NuB	Nunn clay loam, 1 to 3 percent slopes
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TsE	Terry-Vona-Tassel complex, 3 to 20 percent slopes
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TtD	Truckton loamy sand, 3 to 9 percent slopes
TuB	Truckton sandy loam, 1 to 3 percent slopes
TuC	Truckton sandy loam, 3 to 5 percent slopes
TuD	Truckton sandy loam, 3 to 9 percent slopes
UlB	Ulm loam, 1 to 3 percent slopes
UlC	Ulm loam, 3 to 5 percent slopes
UlD	Ulm loam, 5 to 9 percent slopes
VaD	Valent loamy sand, 1 to 9 percent slopes
VnB	Vona loamy sand, 0 to 3 percent slopes
VnD	Vona loamy sand, 3 to 9 percent slopes
VoA	Vona sandy loam, 0 to 1 percent slopes
VoB	Vona sandy loam, 1 to 3 percent slopes
VoC	Vona sandy loam, 3 to 5 percent slopes
VsD	Vona-Ascalon loamy sands, 3 to 9 percent slopes
WmB	Weld loam, 1 to 3 percent slopes
WrB	Weld-Deertrail complex, 0 to 3 percent slopes
Wt	Wet alluvial land
WuE	Wiley-Adena-Renohill complex, 3 to 20 percent slopes

WORKS AND S

Highways and roads

Divided ....

Good motor ....

Poor motor ....

Trail ....

Highway markers

National Interstate ....

U. S. ....

State or county ....

Railroads

Single track ....

Multiple track ....

Abandoned ....

Bridges and crossings

Road ....

Trail ....

Railroad ....

Ferry ....

Ford ....

Grade ....

R. R. over ....

R. R. under ... .

Buildings ....

School ....

Church ....

Mine and quarry . ...

Gravel pit ....

Power line ....

Spreader dam ....

Cemetery ....

Dams ....

Levee ....

Tanks ....

Well, oil or gas ....

Forest fire or lookout station .

Windmill ....

Located object ....

CONVENTIONAL SIGNS

; AND STRUCTURES

station ...

BOUNDARIES

- National or state
- County
- Minor civil division
- Reservation
- Land grant
- Small park, cemetery, airport
- Land survey division corners

DRAINAGE

- Streams, double-line
  - Perennial
  - Intermittent
- Streams, single-line
  - Perennial
  - Intermittent
    - Unclassified
- Canals and ditches
- Lakes and ponds
  - Perennial (water, w)
  - Intermittent (int)
- Spring
- Marsh or swamp
- Wet spot
- Drainage end or alluvial fan
- Well, irrigation
- Well, artesian

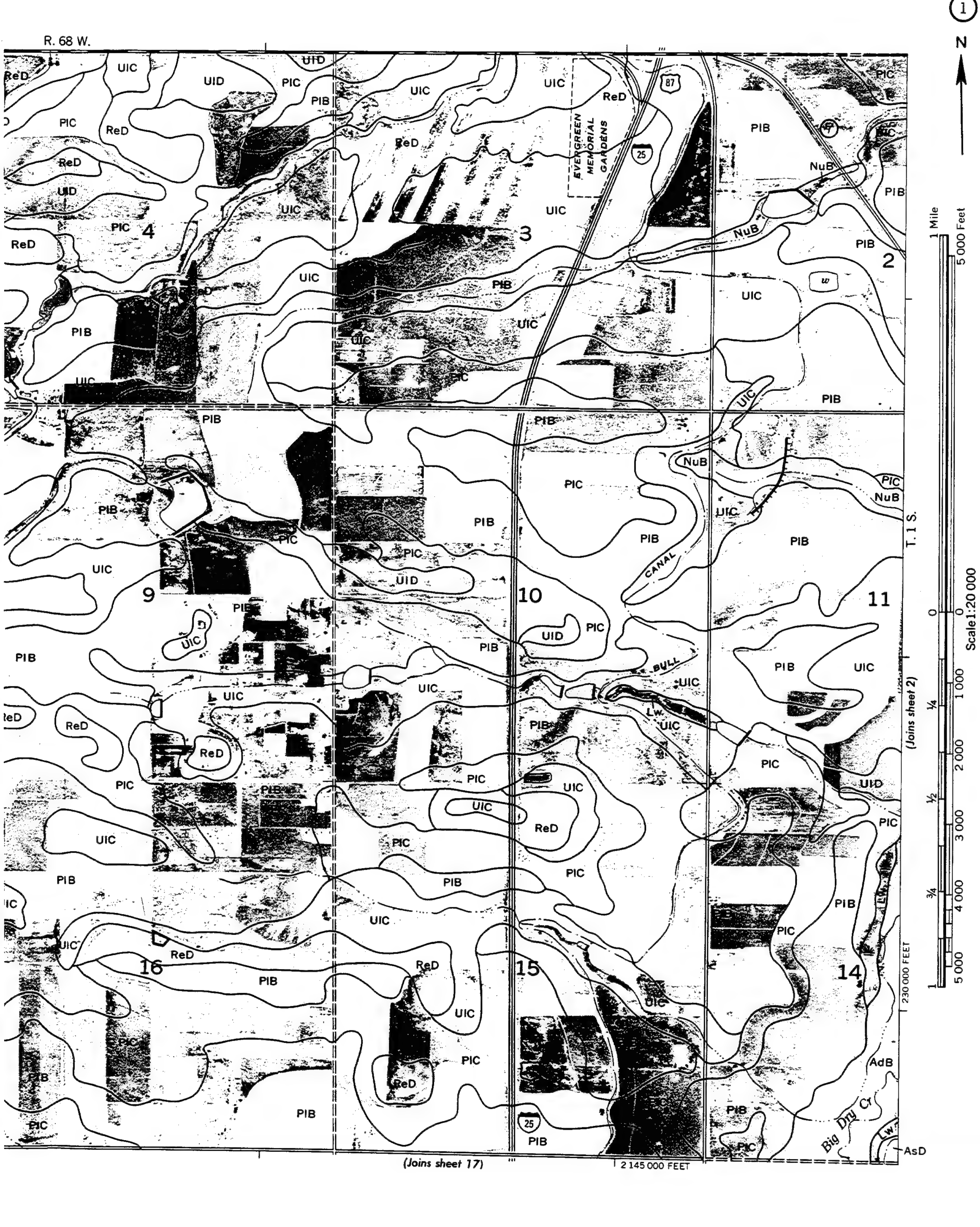
RELIEF

- Escarpments
  - Bedrock
  - Other
- Short steep slope
- Prominent peak
- Depressions (Large, Small)
  - Crossable with tillage implements
  - Not crossable with tillage implements
  - Contains water most of the time

SOIL SURVEY DATA

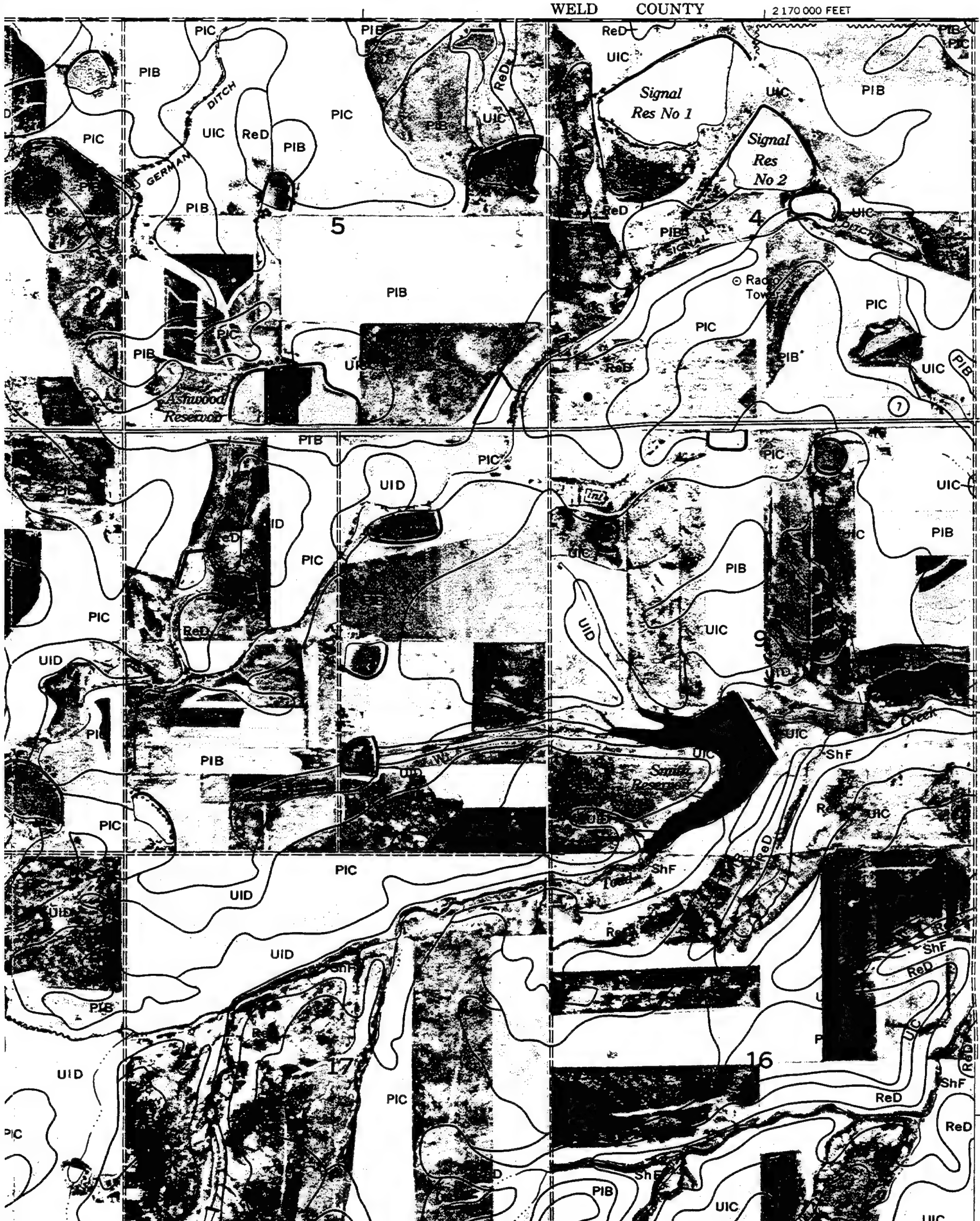
- Soil boundary and symbol (Dx)
- Gravel
- Stoniness
  - Stony
  - Very stony
- Rock outcrops
- Chert fragments
- Clay spot
- Sand spot
- Gumbo or scabby spot
- Made land
- Severely eroded spot
- Blowout, wind erosion
- Gully
- Land fill (L.F.)
- Saline spot

Land division corners are approximately positioned on this map.



1
N
R. 68 W.
T. 1 S.
(Joins sheet 2)
(Joins sheet 17)
2 145 000 FEET
230 000 FEET
EVERGREEN MEMORIAL GARDENS
87
25
CANAL
BULL
Big Dry Cr
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
2
3
4
9
10
11
14
15
16
PIB
PIC
UIC
UID
ReD
NuB
Lw
AdB
AsD

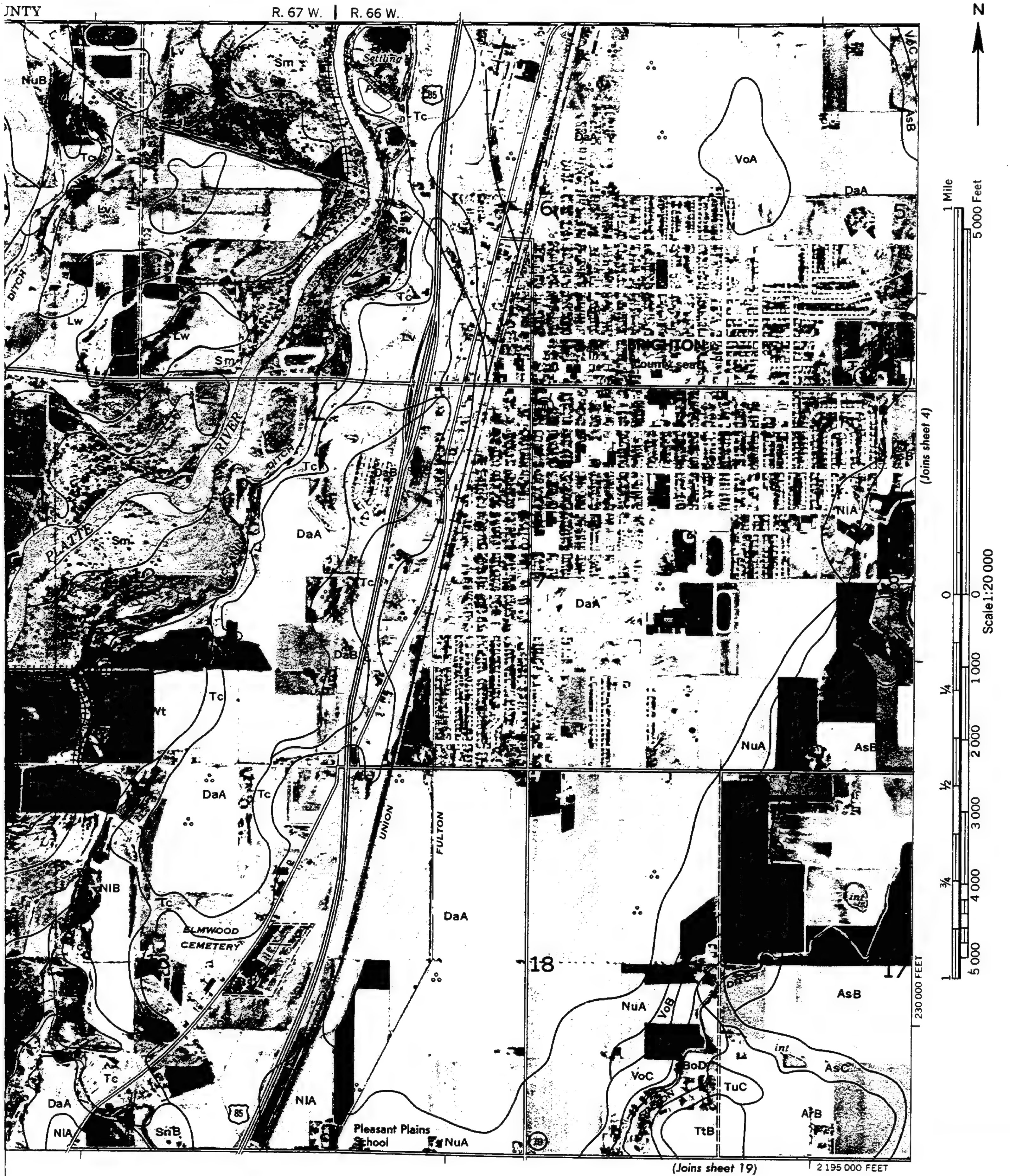

N
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1000
¼
2000
½
3000
¾
4000
1
5000
R. 68 W. | R. 67 W.
(Joins sheet 1)
(Joins sheet 18)
230 000 FEET
2 150 000 FEET
2
6
12
14
18
7
Big Dry Creek
UNION PACIFIC
Wadley Res No 1
Wt
PIB
PIC
UIC
UID
AdB
AsC
AsD
ReD
NuB
Gr



Land division corners are approximately positioned on this map.

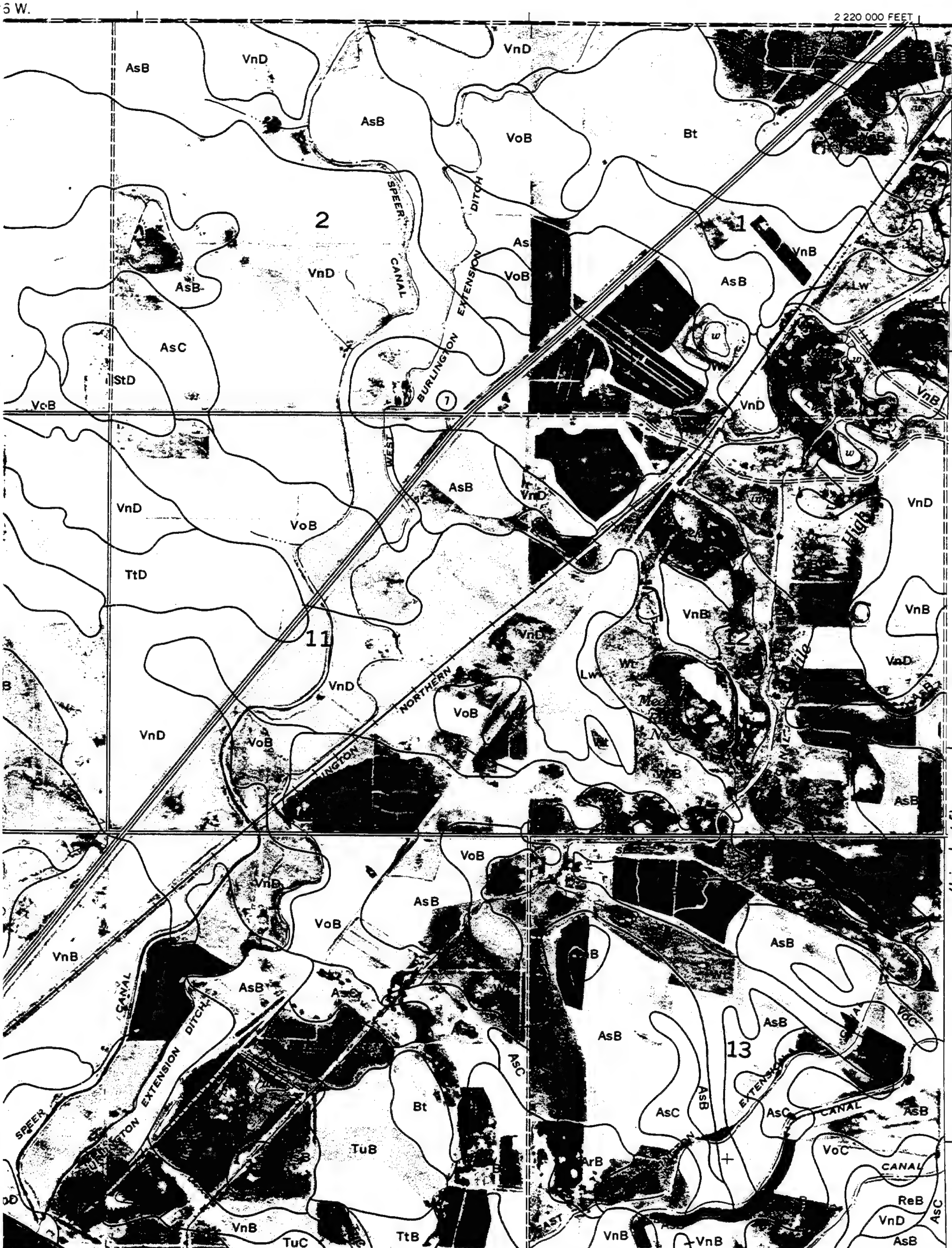
Photobase from 1970 aerial photographs. 5,000-foot grid ticks based on Colorado plane coordinate system, north zone, 1927 North American datum.

Land division corners are approximately positioned on this map.


UNTY
R. 67 W.
R. 66 W.
N
NuB
Lv
Sm
Settling
Pond
85
Tc
DaA
VoA
6
5
1 Mile
5 000 Feet
Lv
Lw
DITCH
Lw
Lw
Sm
Lv
BRIGHTON
County seat
(Joins sheet 4)
RIVER
DITCH
Tc
DaB
PLATTE
Sm
DaA
NlA
Tc
7
DaA
8
0
0
Scale 1:20 000
DaB
Tc
Wt
¼
1 000
NuA
AsB
2 000
½
DaA
Tc
UNION
FULTON
3 000
NlB
DaA
int
¾
4 000
Tc
ELMWOOD
CEMETERY
Tc
18
17
1
5 000
DITCH
AsB
230 000 FEET
NuA
VoB
int
VoC
BoD
TuC
AsC
Tc
DaA
NlA
SmB
85
NlA
Pleasant Plains
School
NuA
ArB
TtB
(Joins sheet 19)
2 195 000 FEET


N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
WELD COUNTY
R. 66 W.
(Joins sheet 3)
(Joins sheet 20)
230 000 FEET
2 200 000 FEET
BRIGHTON
FAIRVIEW CEMETERY
DITCH
LATERAL
FULTON
SPEER
VnB
VnD
VoC
VoB
AsB
DaA
TtB
TtD
TuC
Gr
int
3
4
5
8
9
10
15
17
7
6
80

5 W.



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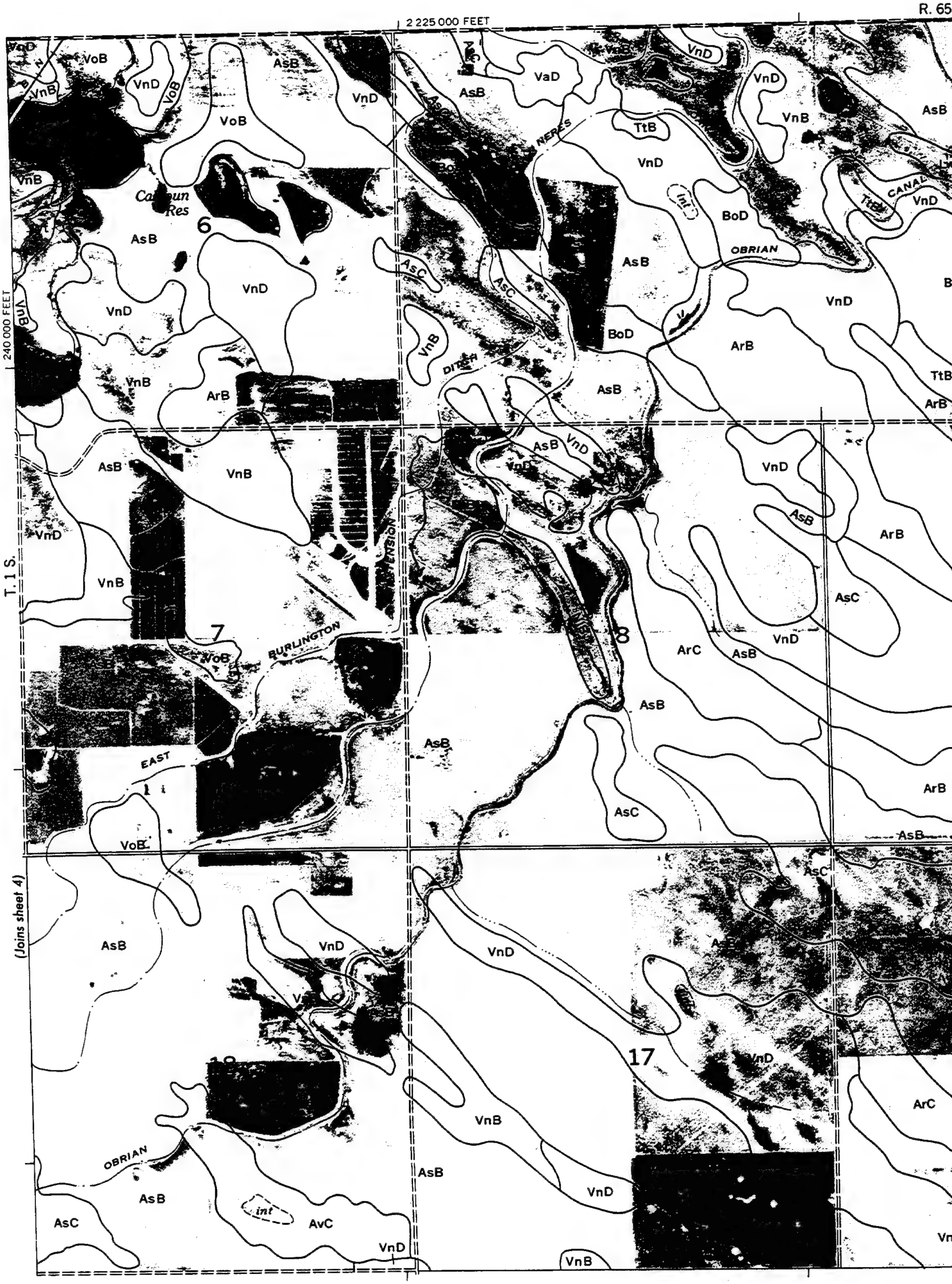
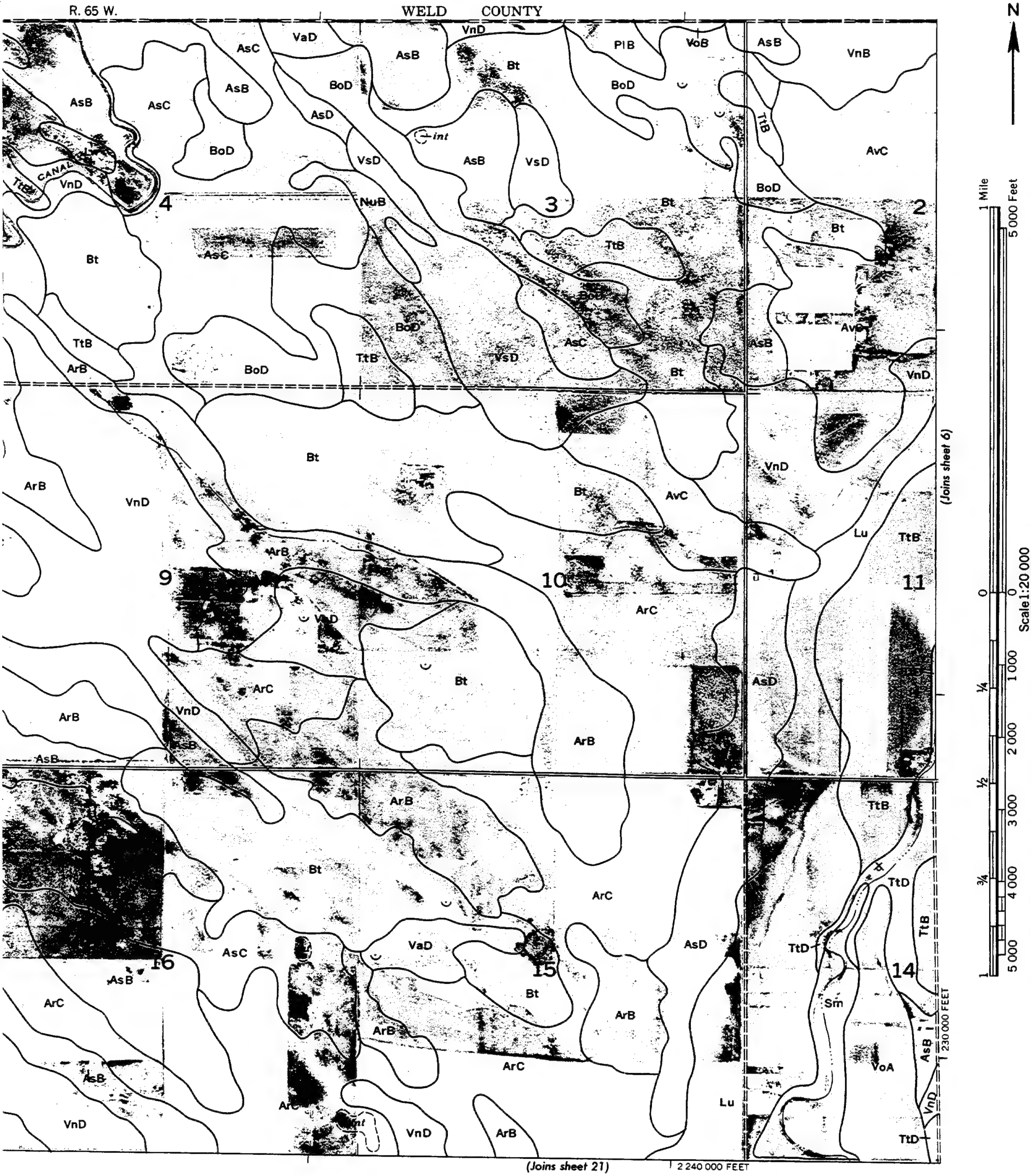
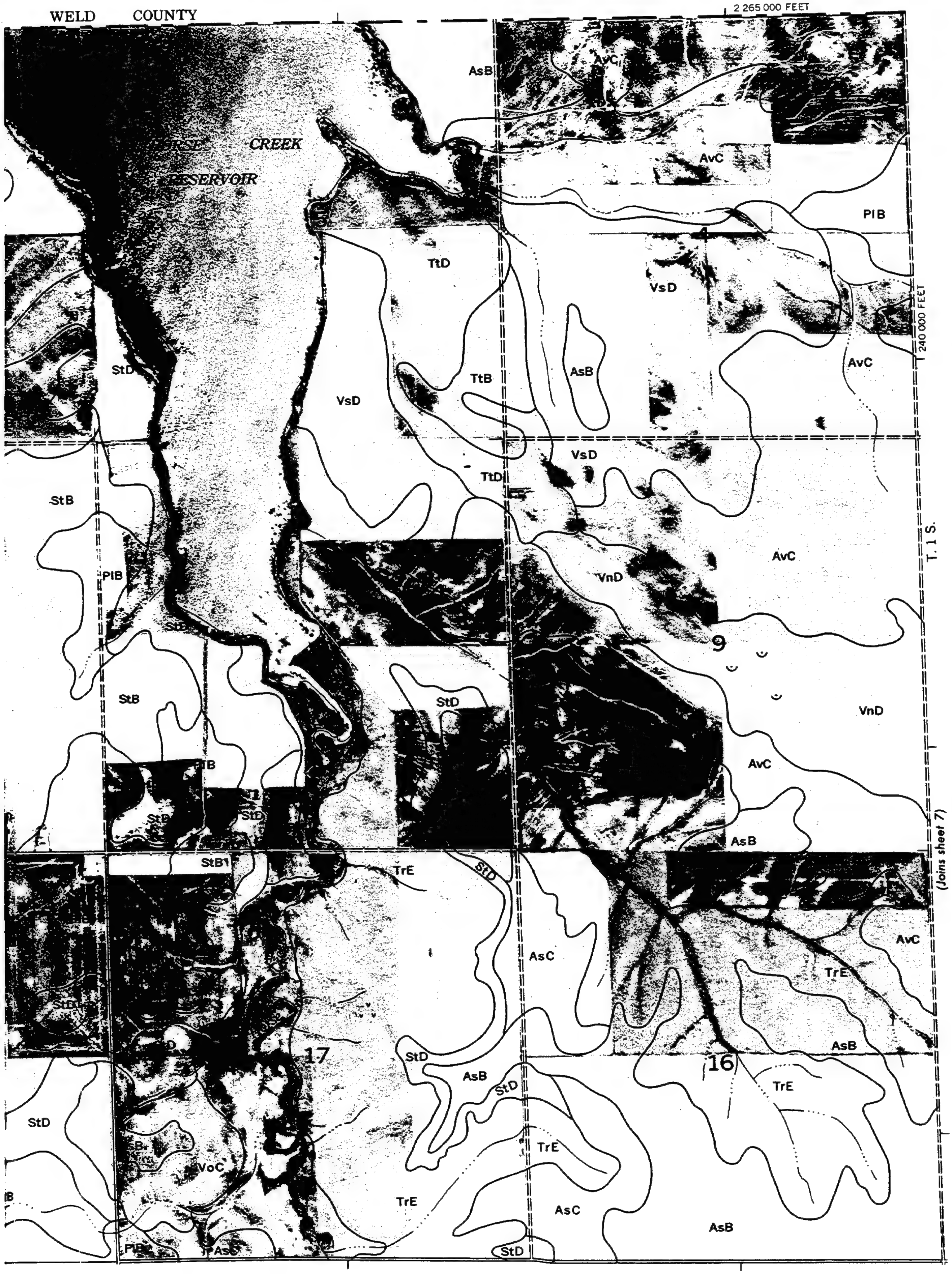


COLORADO — SHEET NUMBER 5

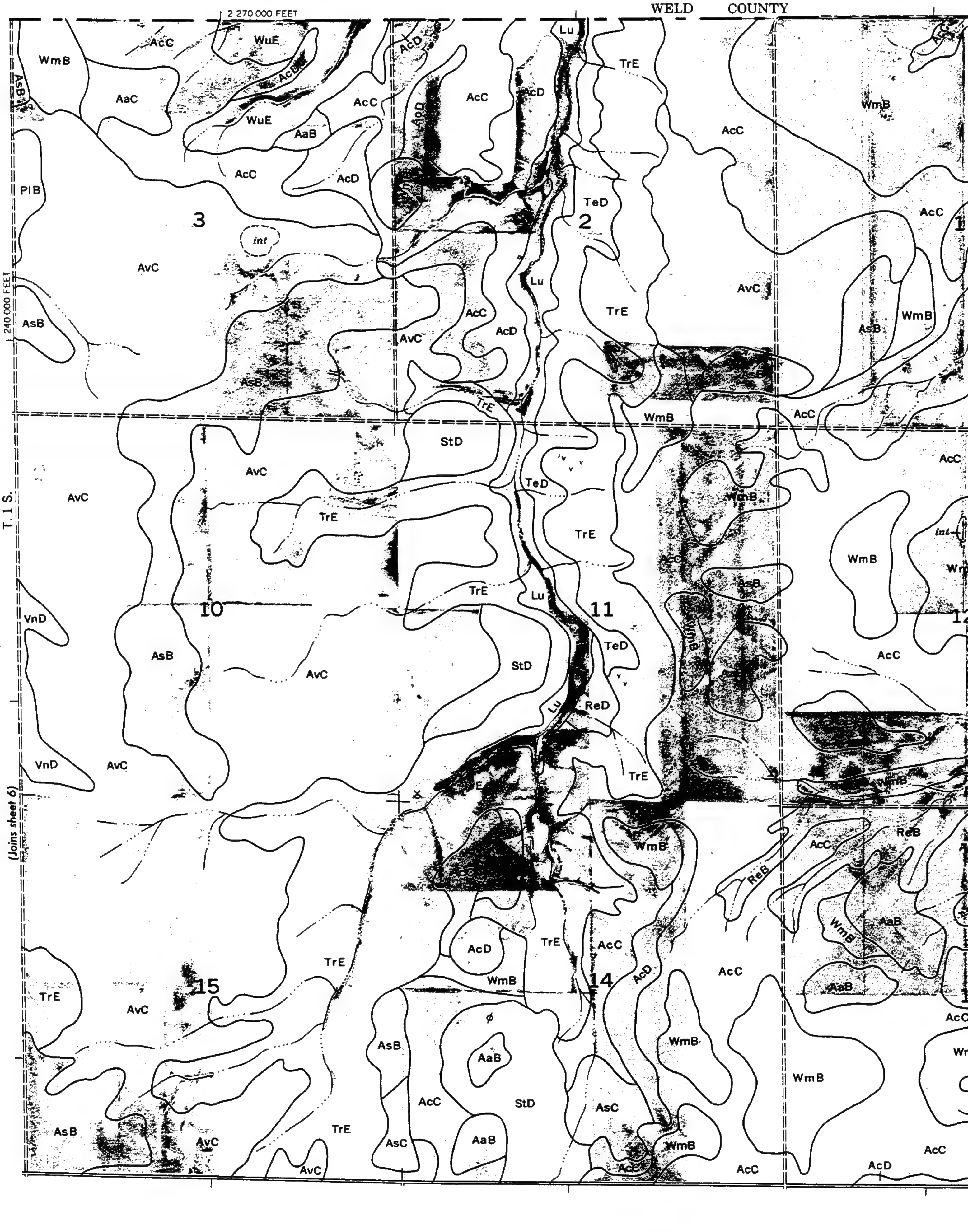
5




6
N
R. 65 W.
R. 64 W.
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 5)
(Joins sheet 22)
2 245 000 FEET
230 000 FEET
HIGHLINE LATERAL
OBRIAN CANAL
OBRIAN CANAL
Box Elder Creek
Boot Lake Reservoir
1
2
6
12
18
VnB
VnD
Bt
TtB
TtD
AsB
AsC
Sm
Lu
AvC
StB
StD
PlB
VoC

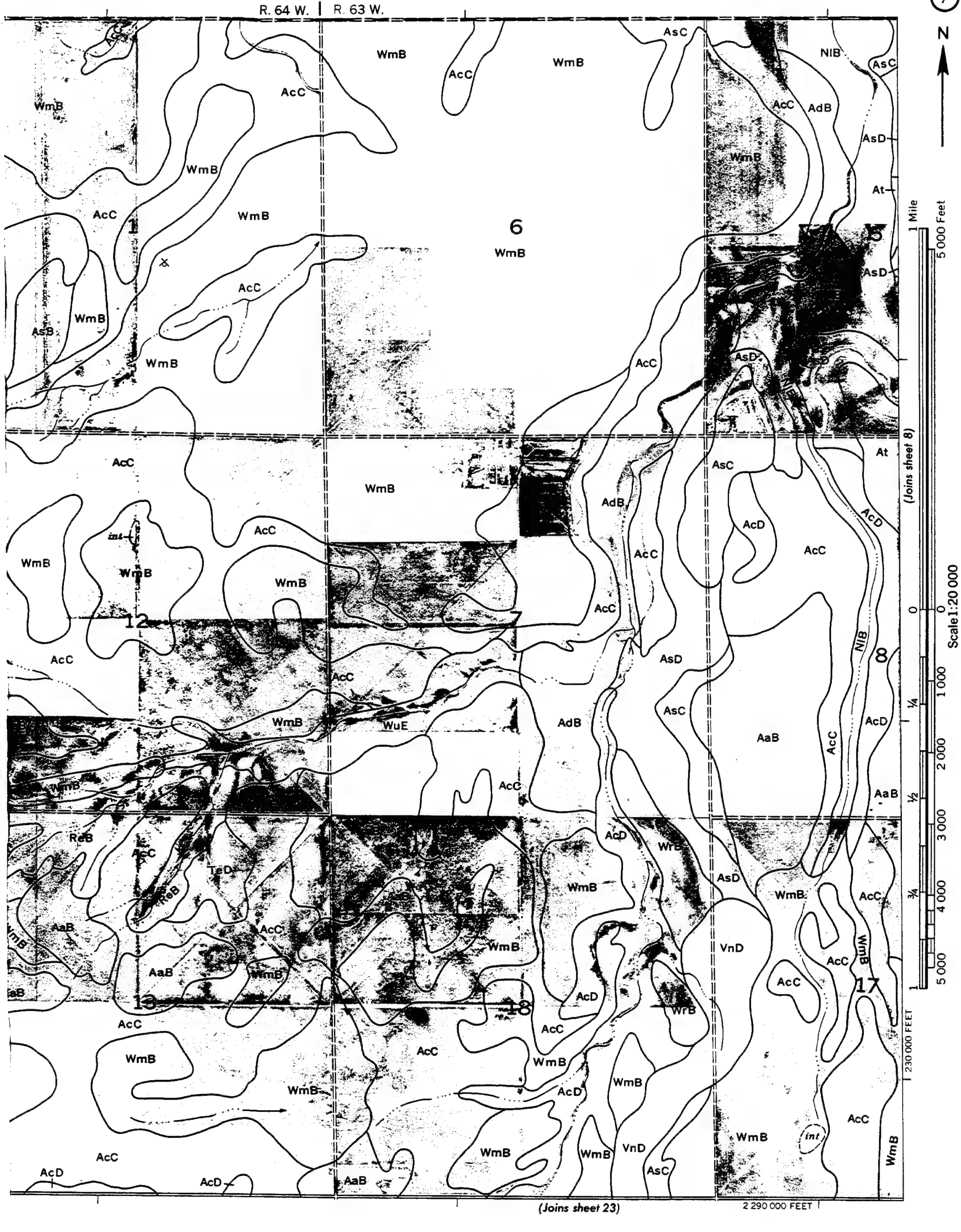


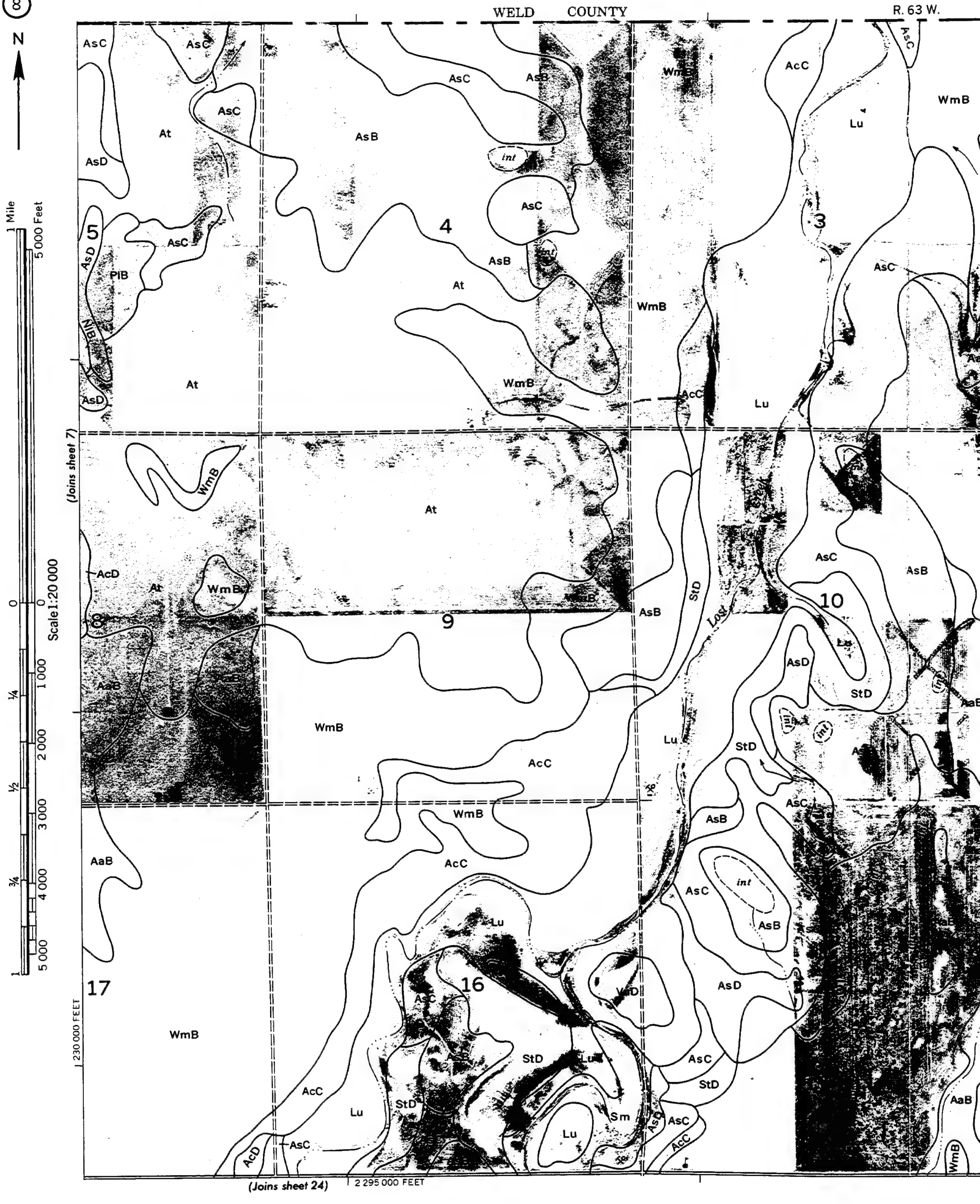
Land division corners are approximately positioned on this map.
Photobase from 1970 aerial photographs. 5,000-foot grid ticks based on Colorado plane coordinate system, north zone. 1927 North American datum.


WELD COUNTY
2 270 000 FEET
240 000 FEET
T. 1 S.
(Joins sheet 6)
3
2
10
11
15
14
12
int
WmB
AsB
AcC
WuE
AcD
AaC
AaB
AcC
PlB
AvC
AsB
Lu
TrE
TeD
StD
TrE
VnD
ReD
ReB
AcD
AsC
AaB

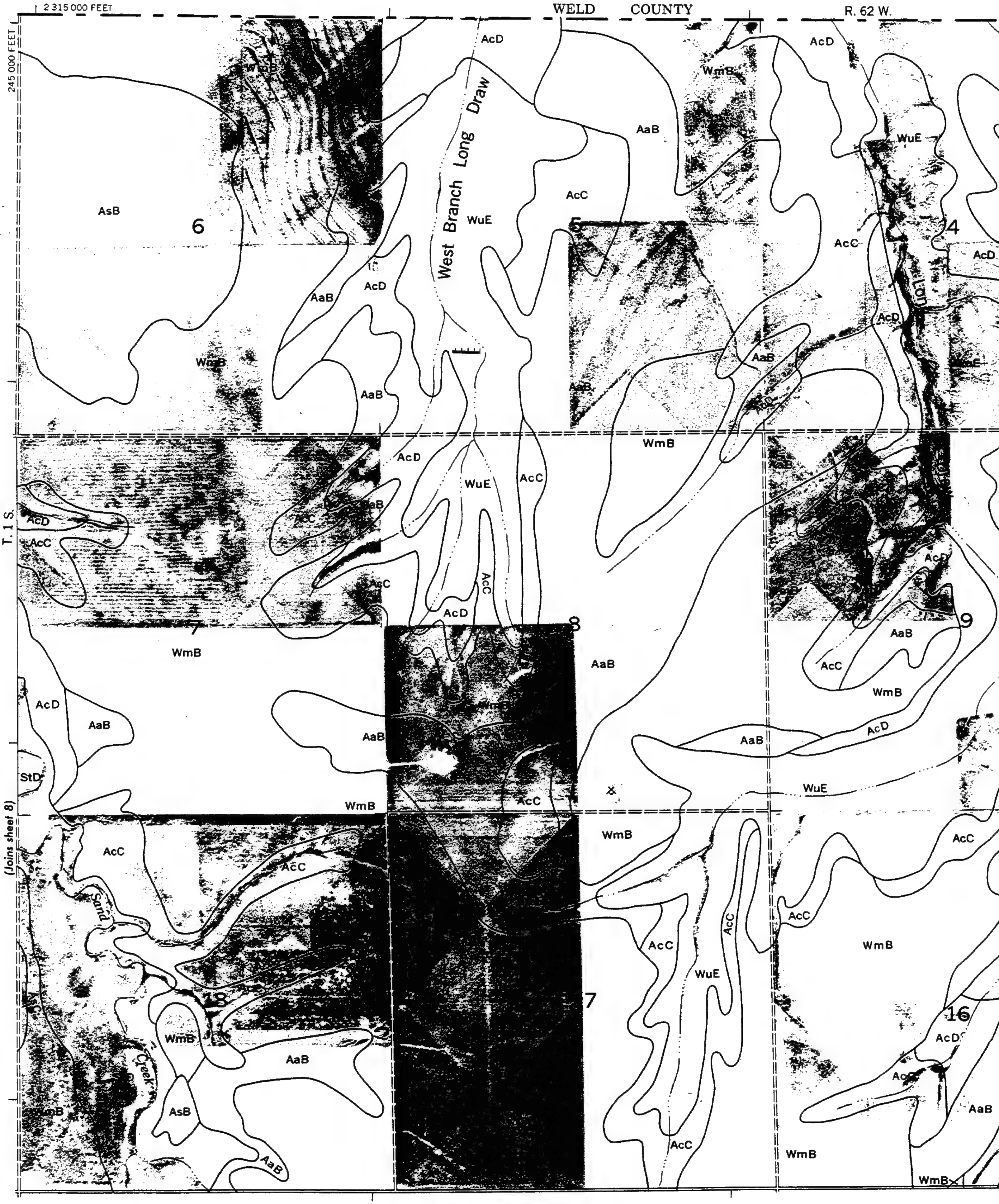
ORADO — SHEET NUMBER 7

7

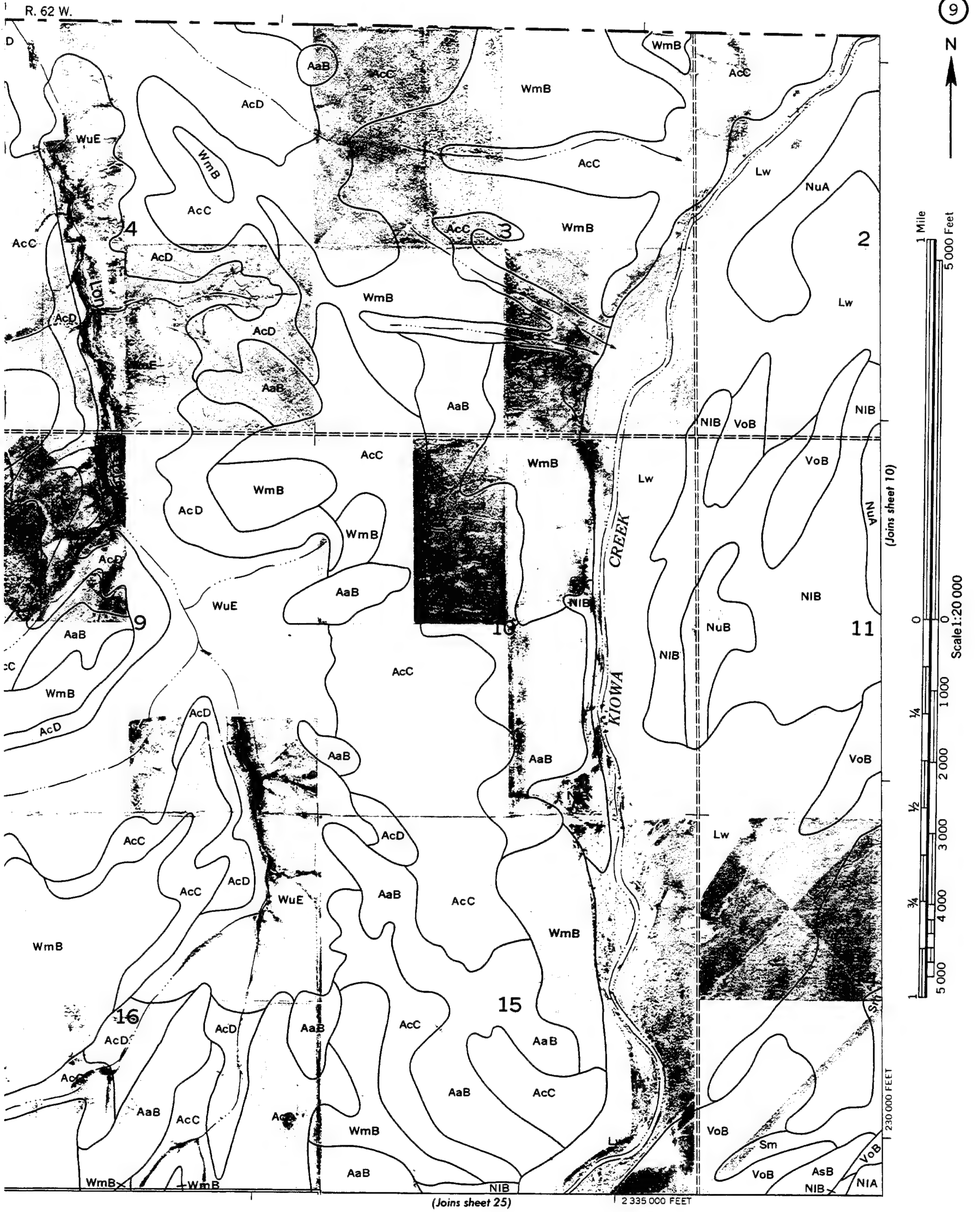


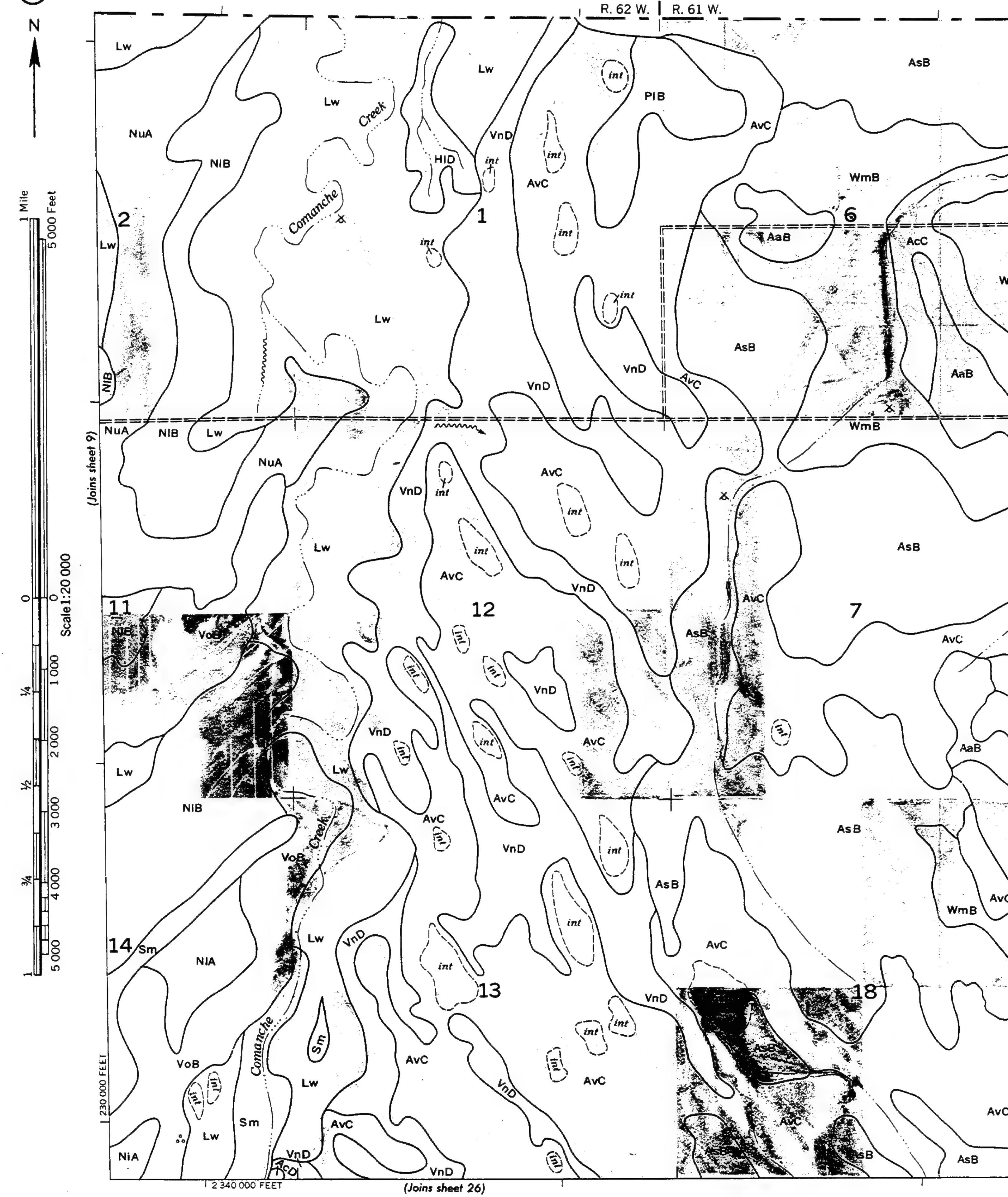

N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
WELD COUNTY
R. 63 W.
(Joins sheet 7)
(Joins sheet 24)
230 000 FEET
2 295 000 FEET
5
4
3
9
10
16
17
AsC
AsD
At
AsB
PlB
WmB
AcD
AaB
AcC
Lu
StD
Lost Creek
int
Sm

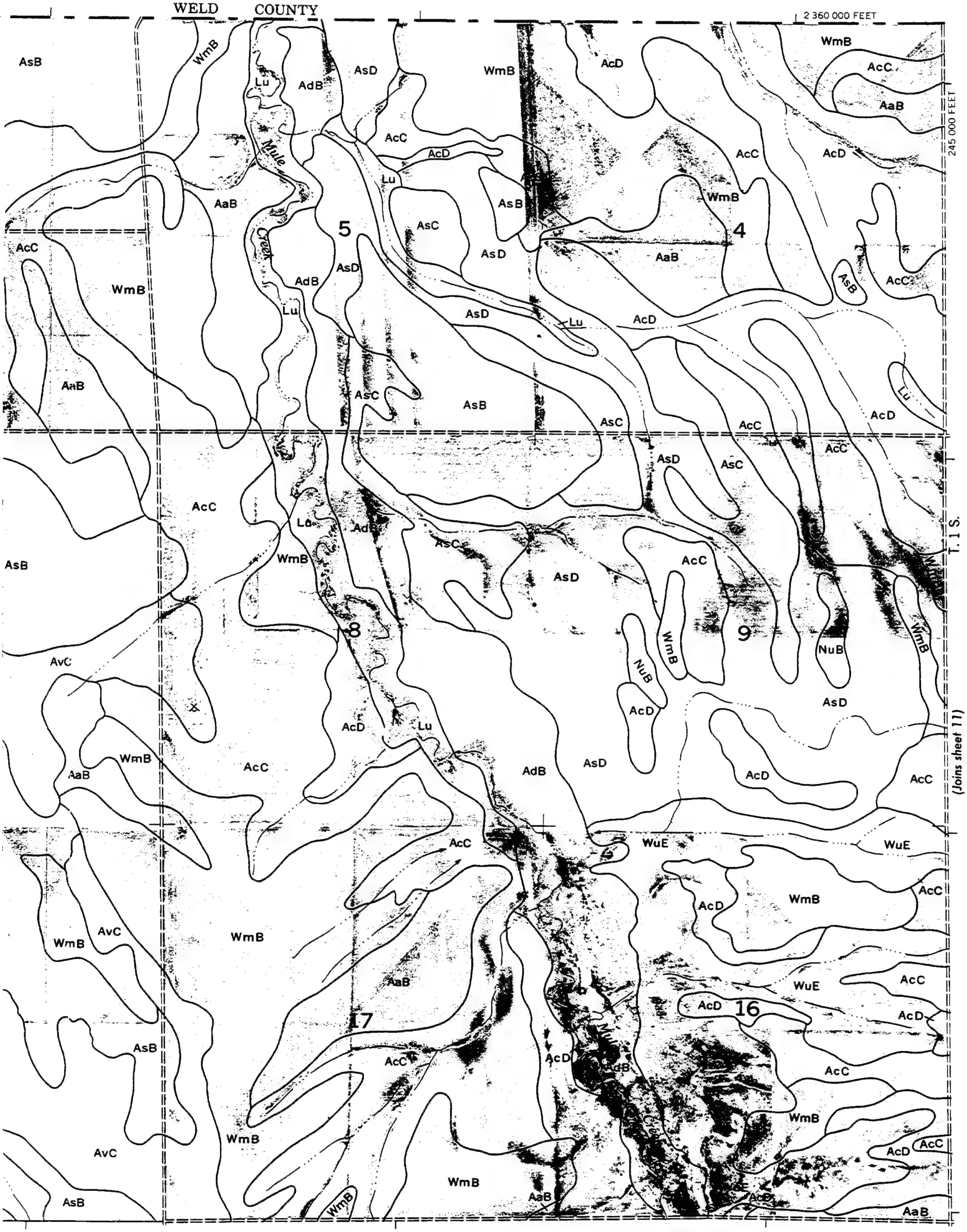

. 63 W.
2 310 000 FEET
245 000 FEET
AsC
AsC
(int)
AsC
AsB
AsB
79
WmB
VnD
Lu
AsC
AsB
PlB
WmB
VnD
Lu
StD
2
AsC
WmB
(int)
AsB
AcC
StD
AcC
Lu
StD
Lu
AcD
AcC
AsB
AaB
Lu
StD
WmB
Creek
AcC
AcD
AcD
Lu
AcD
AcC
WmB
T. 1 S.
StD
AsB
WmB
11
(int)
AaB
AsC
12
AsD
AsD
AsD
StD
Lu
(Joins sheet 9)
AcC
AsD
mB
14
StD
AsC
AsD
Lu
AcD
AaB
WmB
WmB
AcD
WmB
AcC

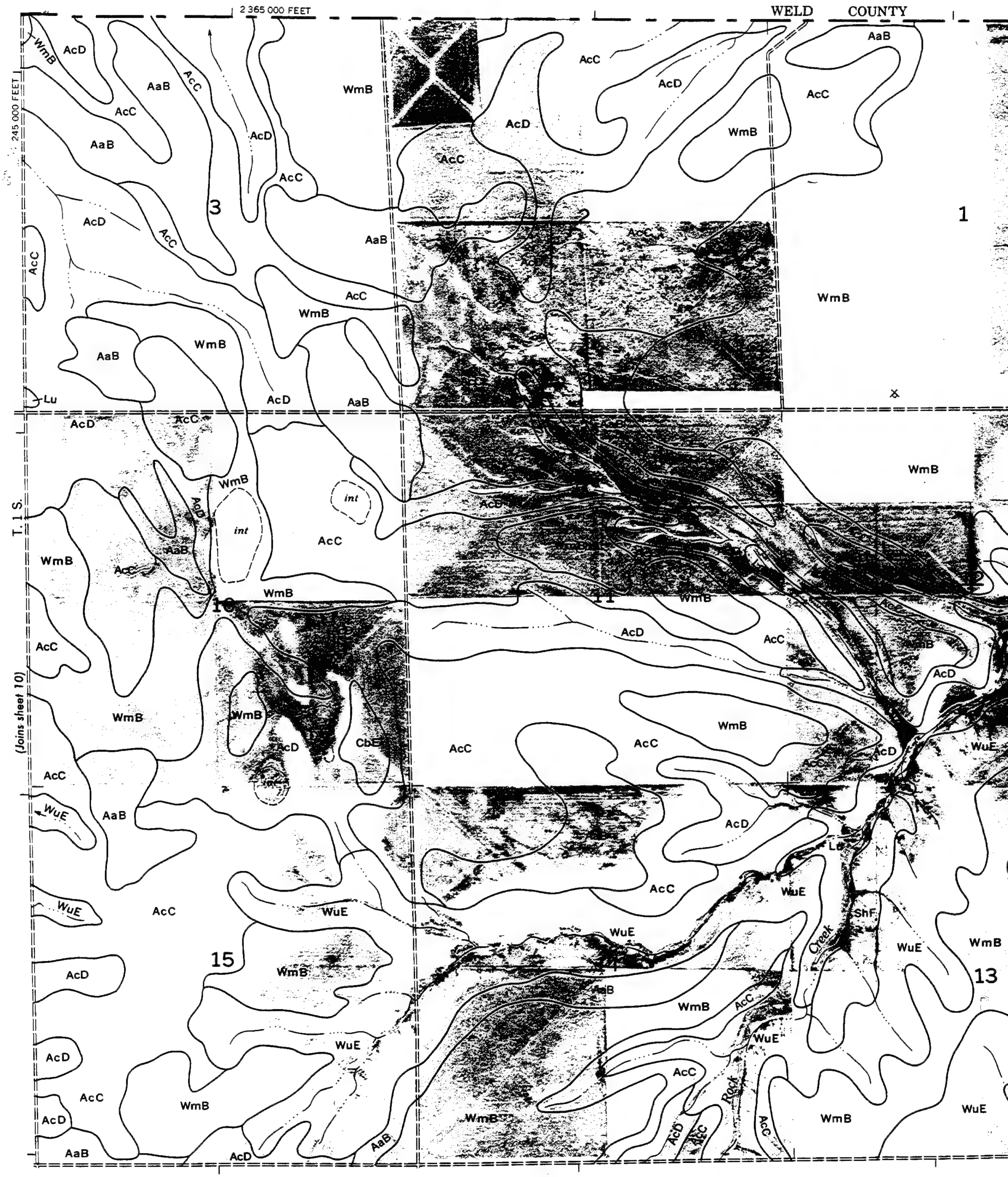

2 315 000 FEET
245 000 FEET
WELD COUNTY
R. 62 W.
T. 1 S.
(Joins sheet 8)
West Branch Long Draw
Sand Creek
6
5
4
7
8
9
18
17
16
AsB
WmB
AcD
AcC
AaB
WuE
StD

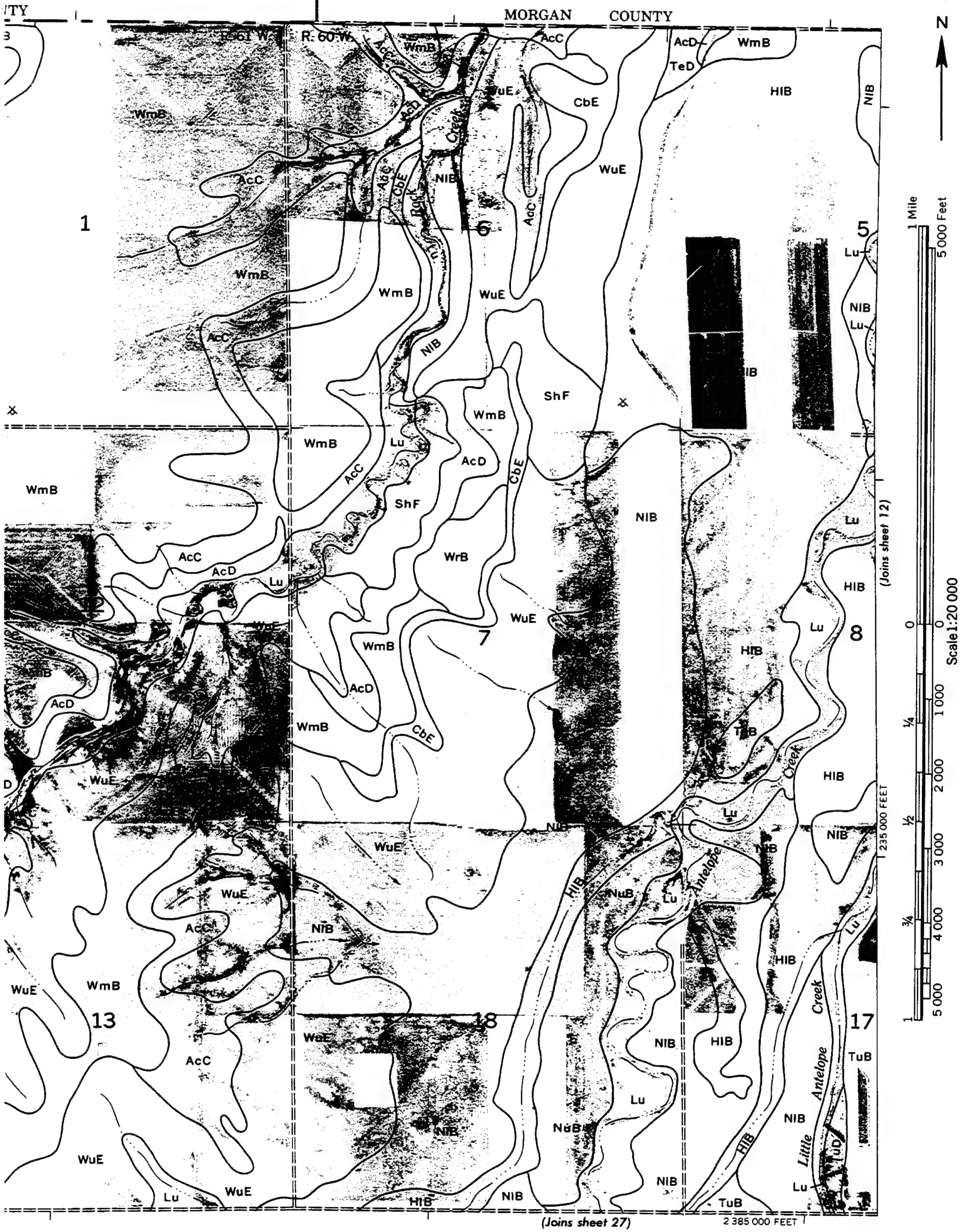
LORADO — SHEET NUMBER 9




N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
R. 62 W.
R. 61 W.
(Joins sheet 9)
(Joins sheet 26)
2 340 000 FEET
230 000 FEET
Comanche Creek
Comanche Creek
Comanche
1
2
6
7
11
12
13
14
18
Lw
NuA
NlB
NlA
HlD
VnD
AvC
PlB
AsB
AaB
AcC
AcD
WmB
VoB
Sm
NiA
int

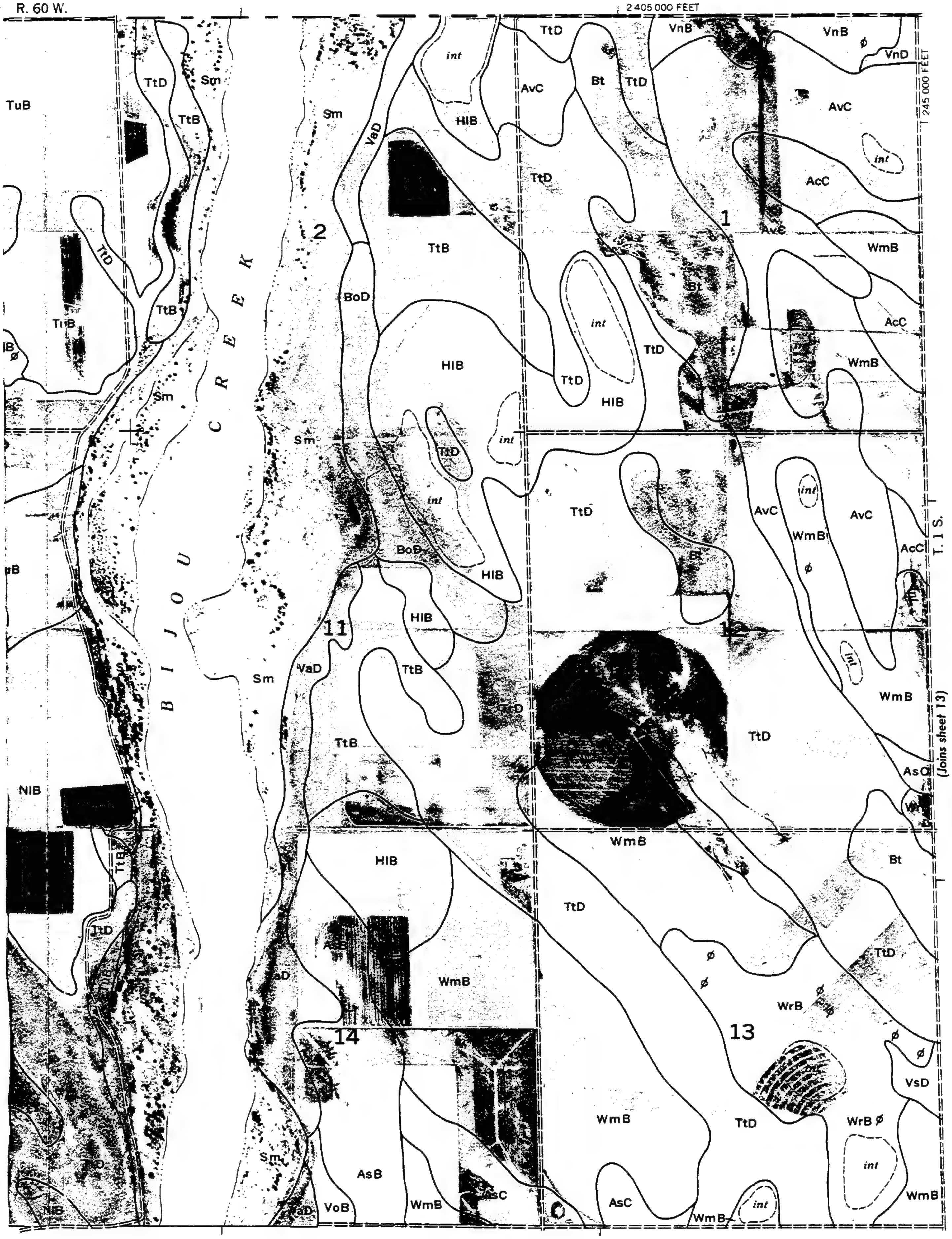

WELD COUNTY
2 360 000 FEET
245 000 FEET
T. 1 S.
(Joins sheet 11)
Mule Creek
5
4
8
9
17
16
AsB
WmB
Lu
AdB
AsD
AcC
AcD
AaB
AsC
AvC
NuB
WuE

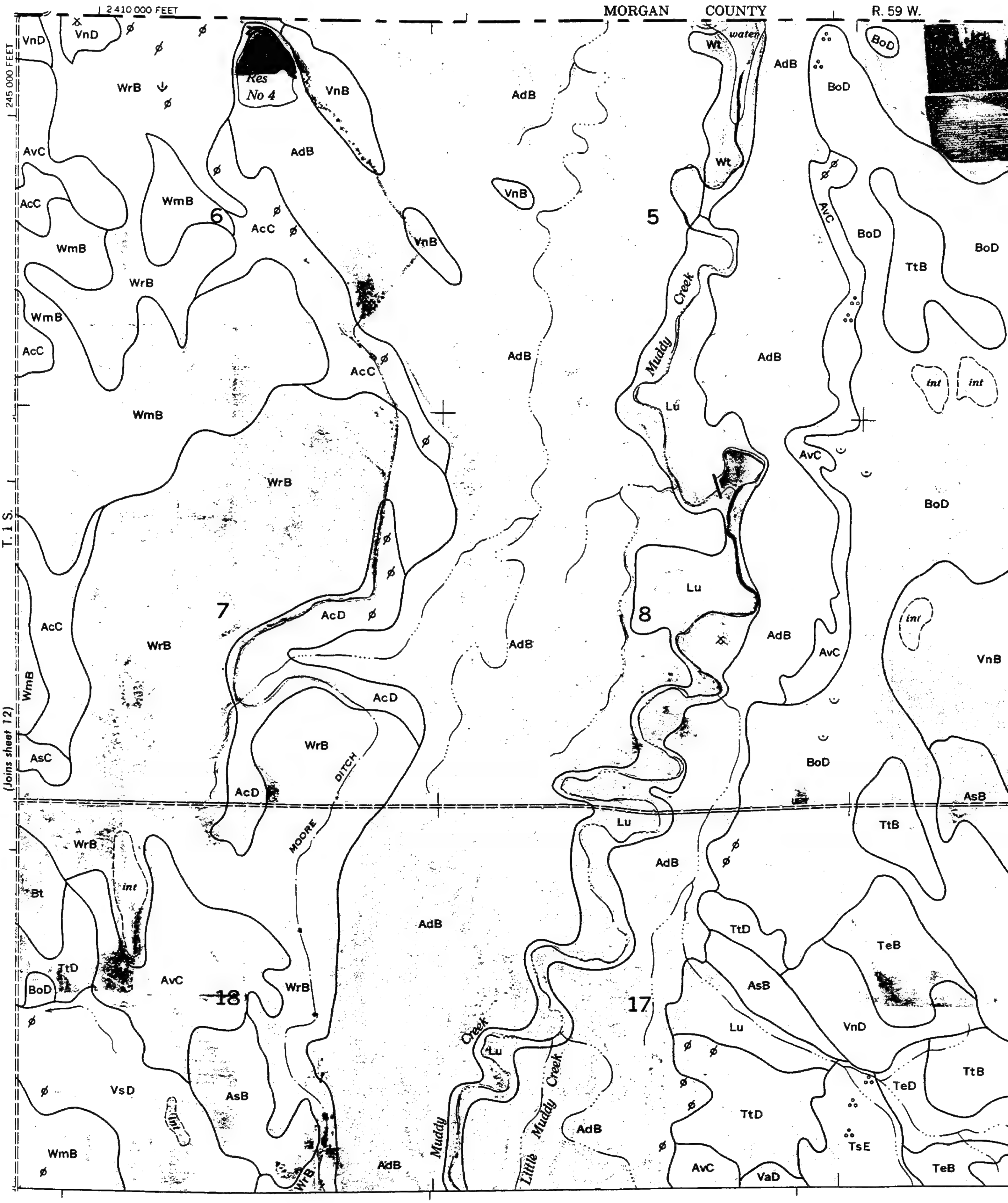

2 365 000 FEET
245 000 FEET
WELD COUNTY
T. 1 S.
(Joins sheet 10)
Rock
Creek
3
1
10
11
15
13
AcD
AaB
AcC
WmB
Lu
int
CbE
WuE
ShF
Lu

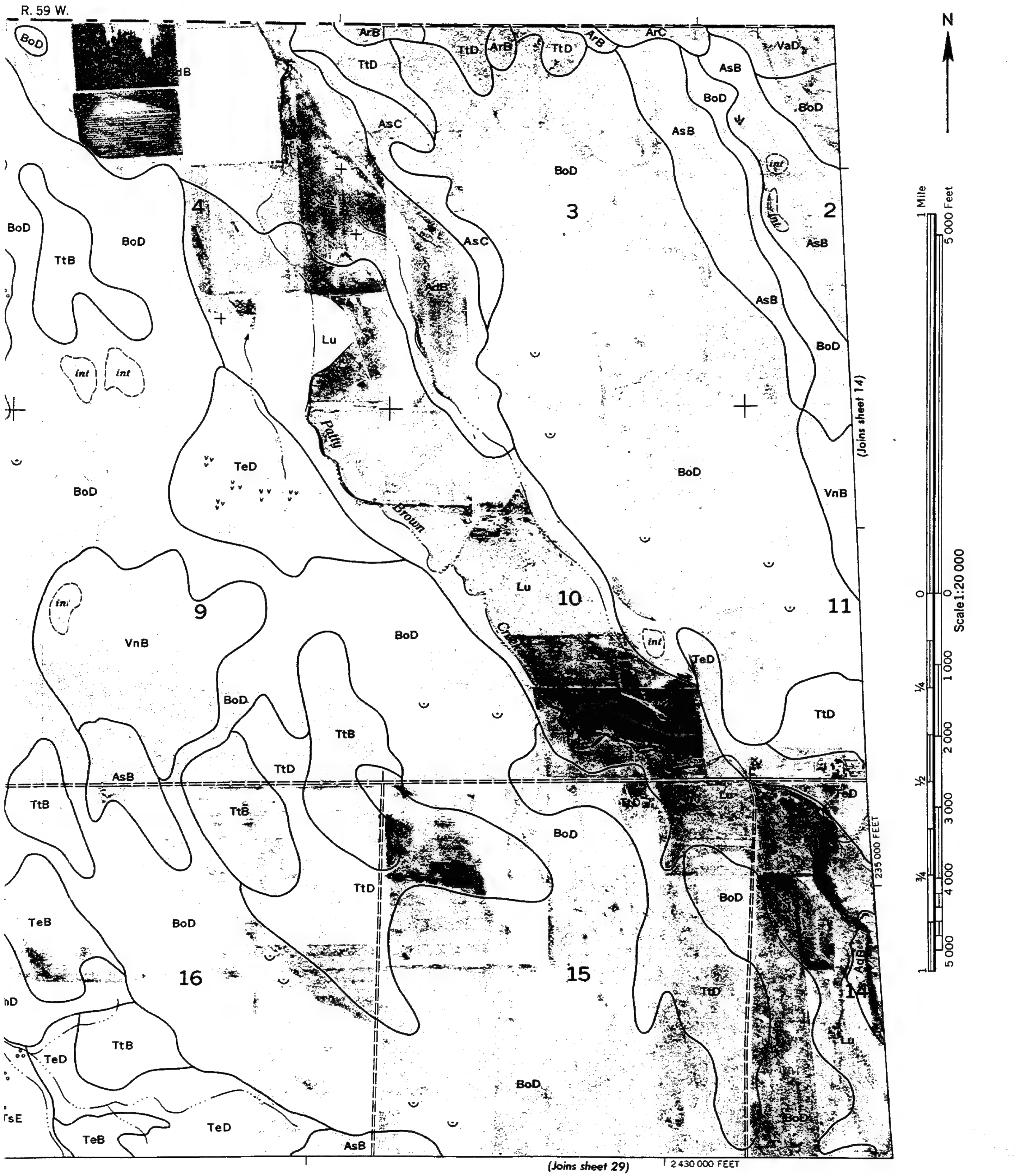

MORGAN COUNTY
R. 61 W.
R. 60 W.
N
WmB
AcC
AcD
TeD
HIB
NIB
CbE
WuE
Creek
Rock
ShF
Lu
WrB
NuB
TuB
Antelope
Little Antelope Creek
1
5
6
7
8
13
17
18
(Joins sheet 12)
(Joins sheet 27)
235 000 FEET
2 385 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000


N
1 Mile
5 000 Feet
Scale 1:20 000
MORGAN COUNTY
R. 60 W.
(Joins sheet 11)
(Joins sheet 28)
235 000 FEET
2 390 000 FEET
Antelope Creek
Little
RESERVOIR
(abandoned)
3
4
5
8
9
10
16
17
TtB
TuB
TtD
TuC
HIB
NIB
Lu
VaD
AdB

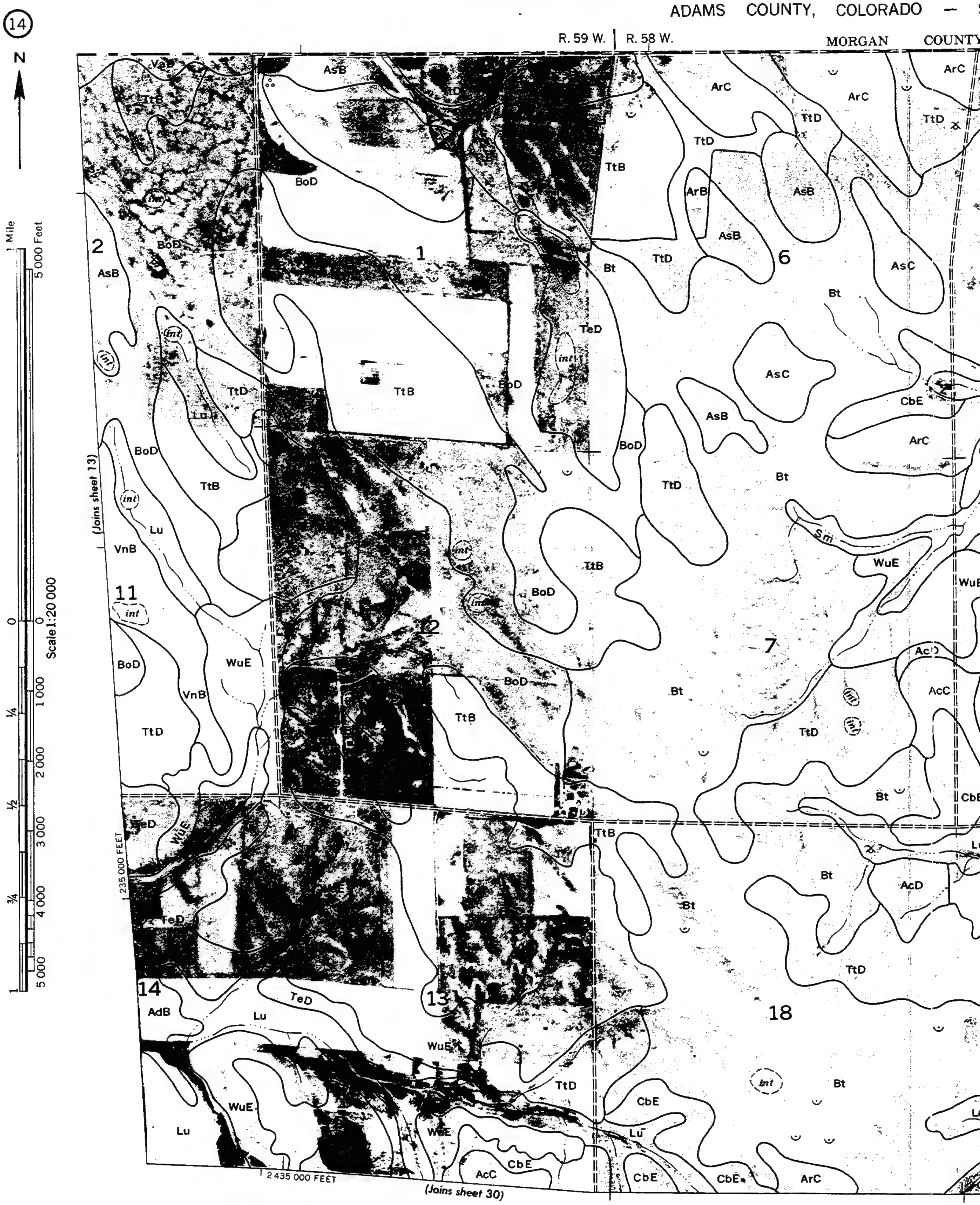
.ORADO — SHEET NUMBER 12

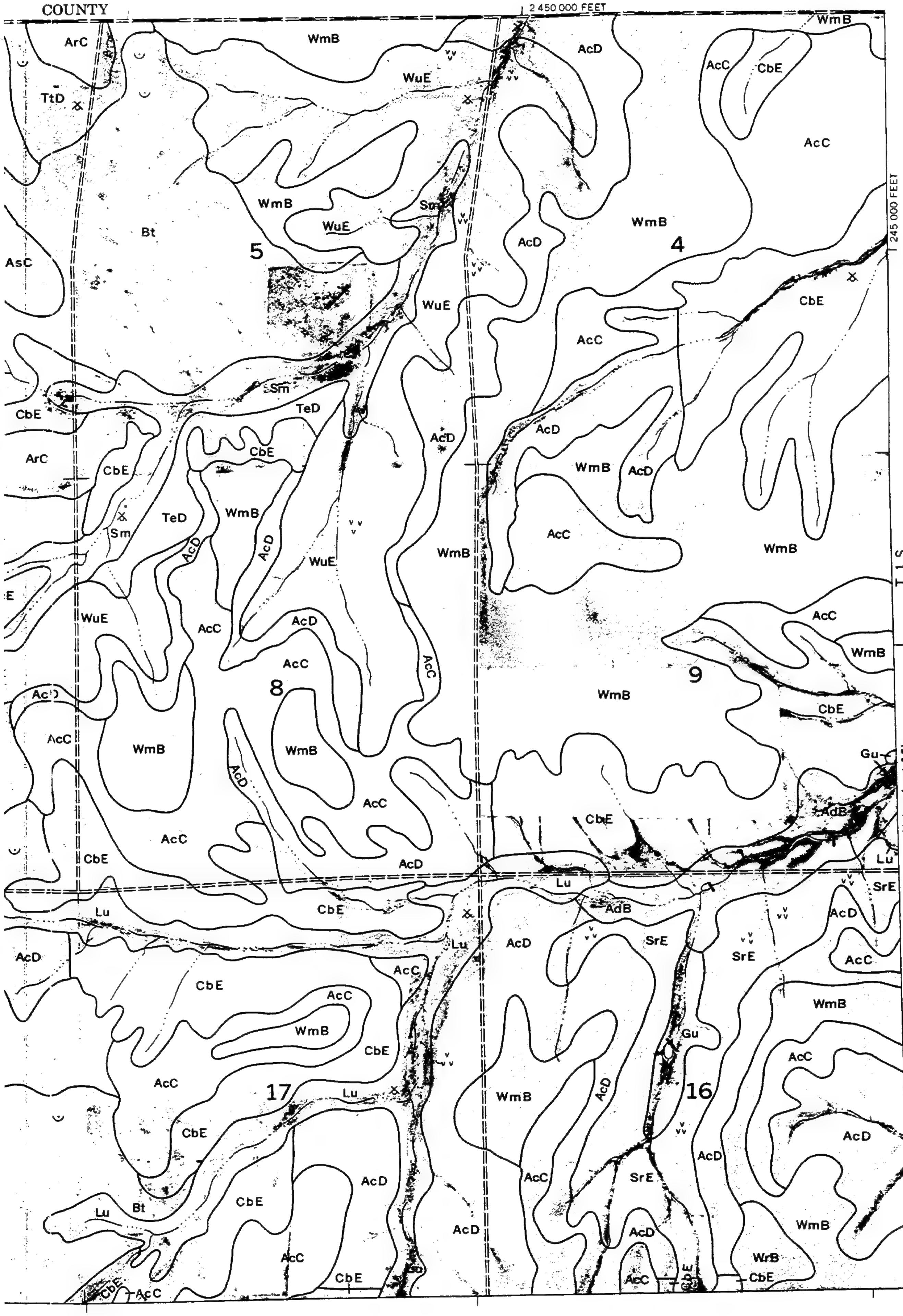



MORGAN COUNTY
R. 59 W.
2 410 000 FEET
245 000 FEET
T. 1 S.
(Joins sheet 12)
Res No 4
water
Muddy Creek
Little Muddy Creek
MOORE DITCH
6
5
7
8
18
17
VnD
WrB
VnB
AdB
AvC
AcC
WmB
AcD
AsC
Wt
BoD
TtB
Lu
int
VsD
AsB
Bt
TtD
TeB
VnD
TeD
TsE
VaD

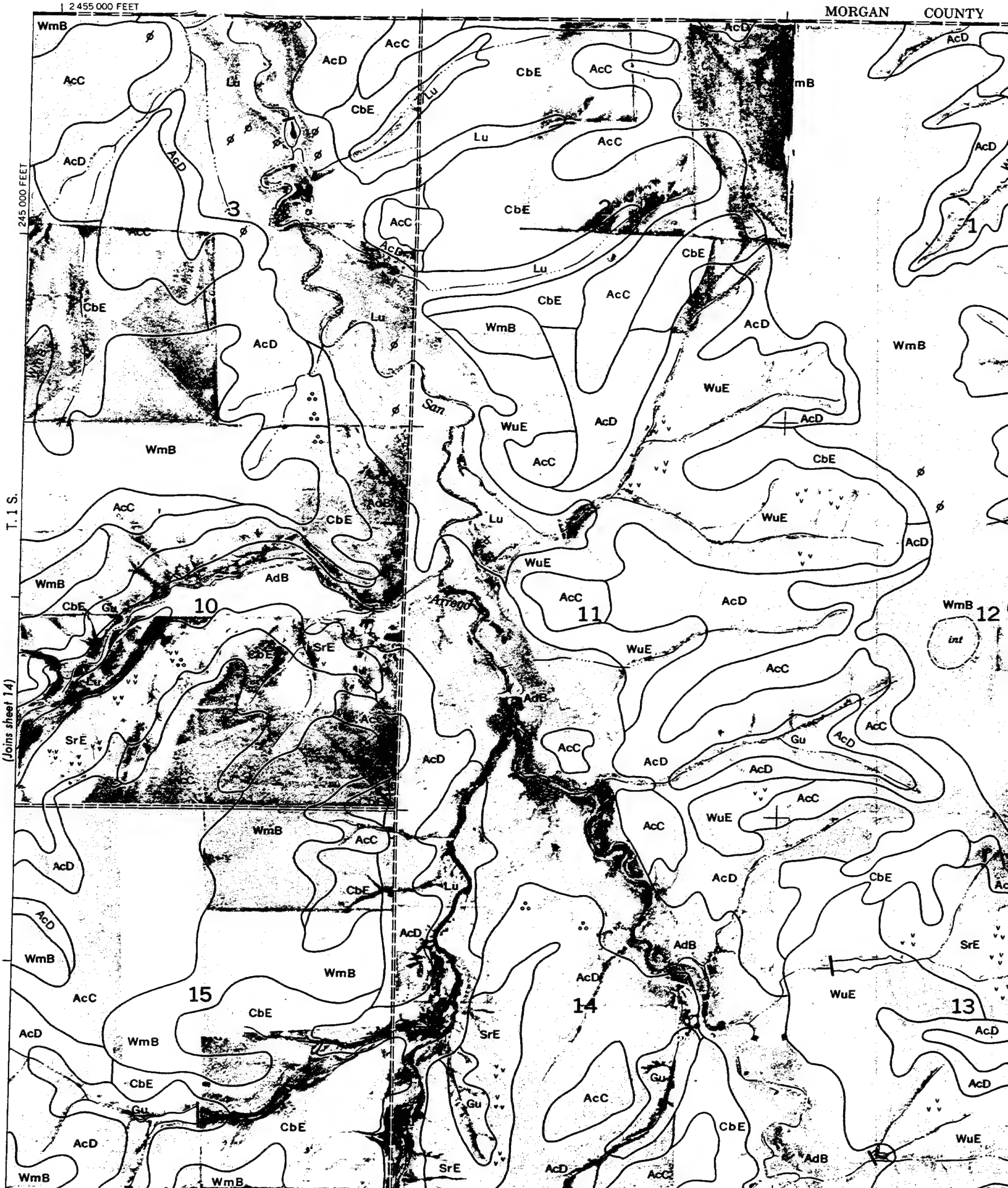


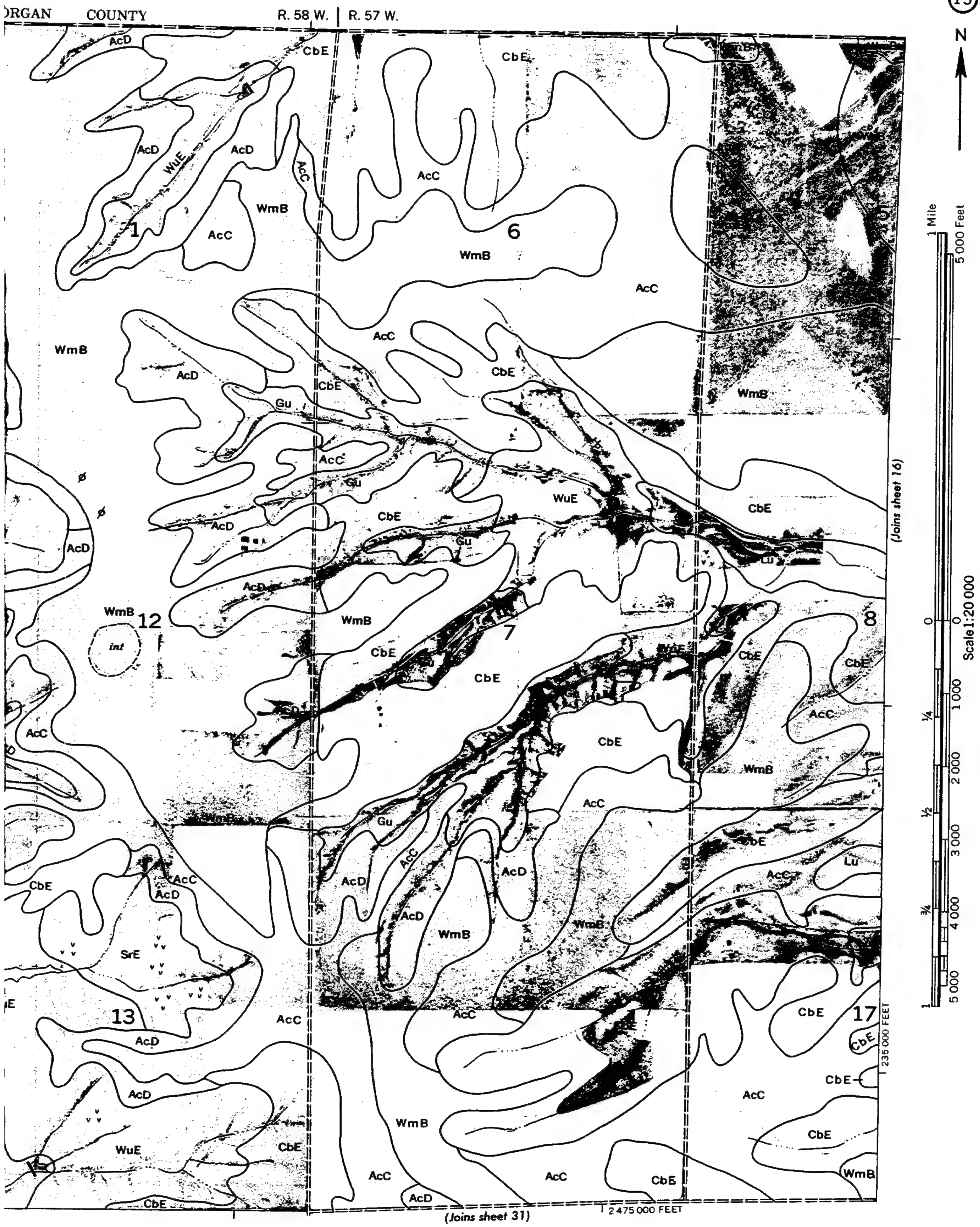
13
N
R. 59 W.
BoD
dB
ArB
TtD
ArB
TtD
ArB
ArC
VaD
AsB
BoD
BoD
AsC
AsB
BoD
int
4
3
2
BoD
BoD
TtB
AsC
AsB
AdB
AsB
Lu
BoD
int
int
Patty
TeD
BoD
BoD
Brown
VnB
(Joins sheet 14)
int
9
Lu
10
11
VnB
BoD
Creek
int
TeD
BoD
TtB
TtD
TtD
AsB
TtB
TtB
BoD
Lu
TeD
TtD
BoD
235 000 FEET
TeB
BoD
16
15
TtD
AdB
14
hD
Lu
TtB
TeD
BoD
TsE
TeB
TeD
AsB
BoD
(Joins sheet 29)
2 430 000 FEET
1 Mile
5 000 Feet
0
0
Scale 1:20 000
¼
1 000
2 000
½
3 000
¾
4 000
1
5 000

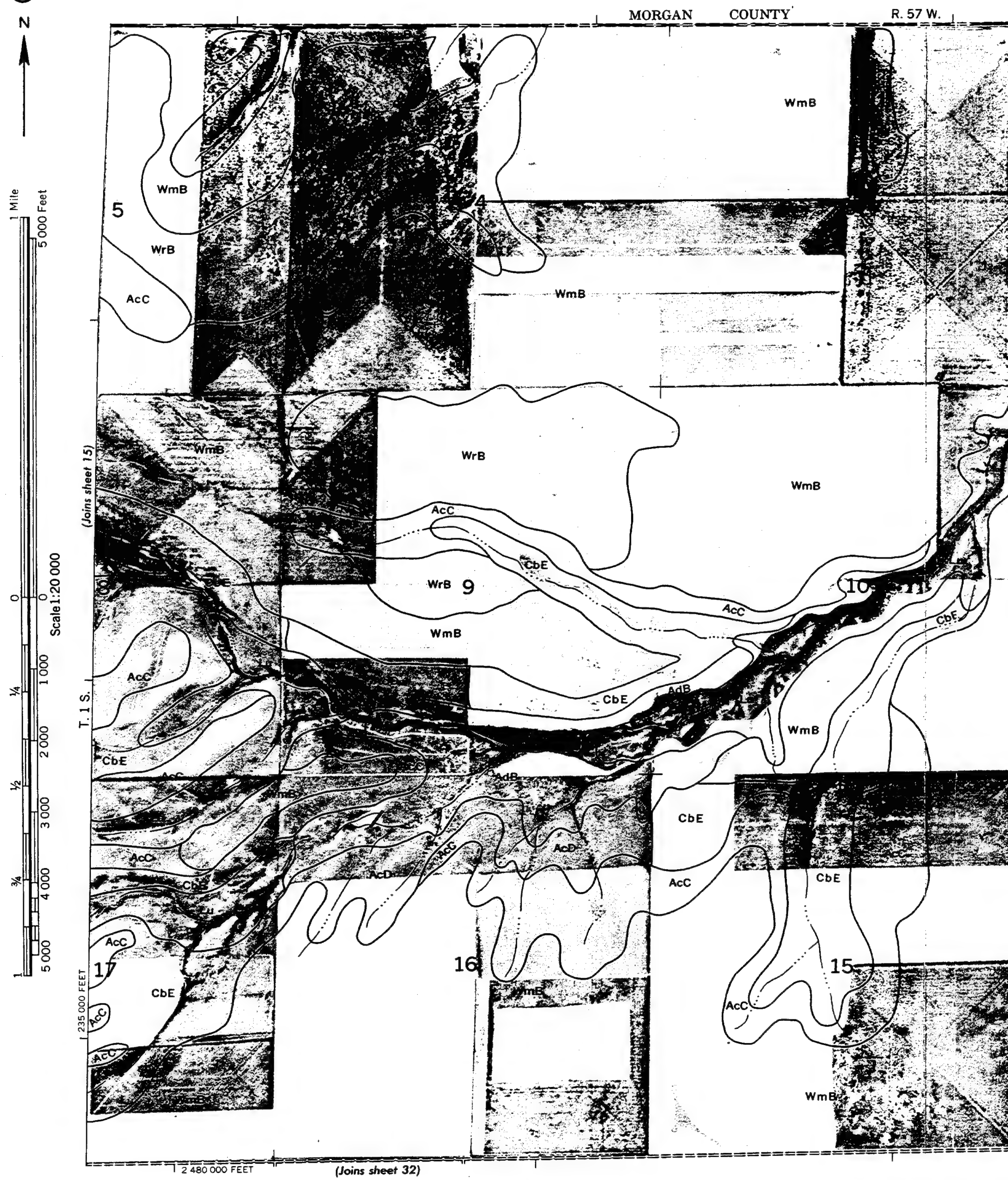

14
N
1 Mile
5 000 Feet
0
0
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
1
Scale 1:20 000
R. 59 W.
R. 58 W.
MORGAN COUNTY
(Joins sheet 13)
(Joins sheet 30)
235 000 FEET
2 435 000 FEET
1
2
6
7
11
12
13
14
18
AsB
AsC
ArB
ArC
BoD
Bt
TtB
TtD
TeD
Lu
VnB
WuE
CbE
AcC
AcD
AdB
Sm
int

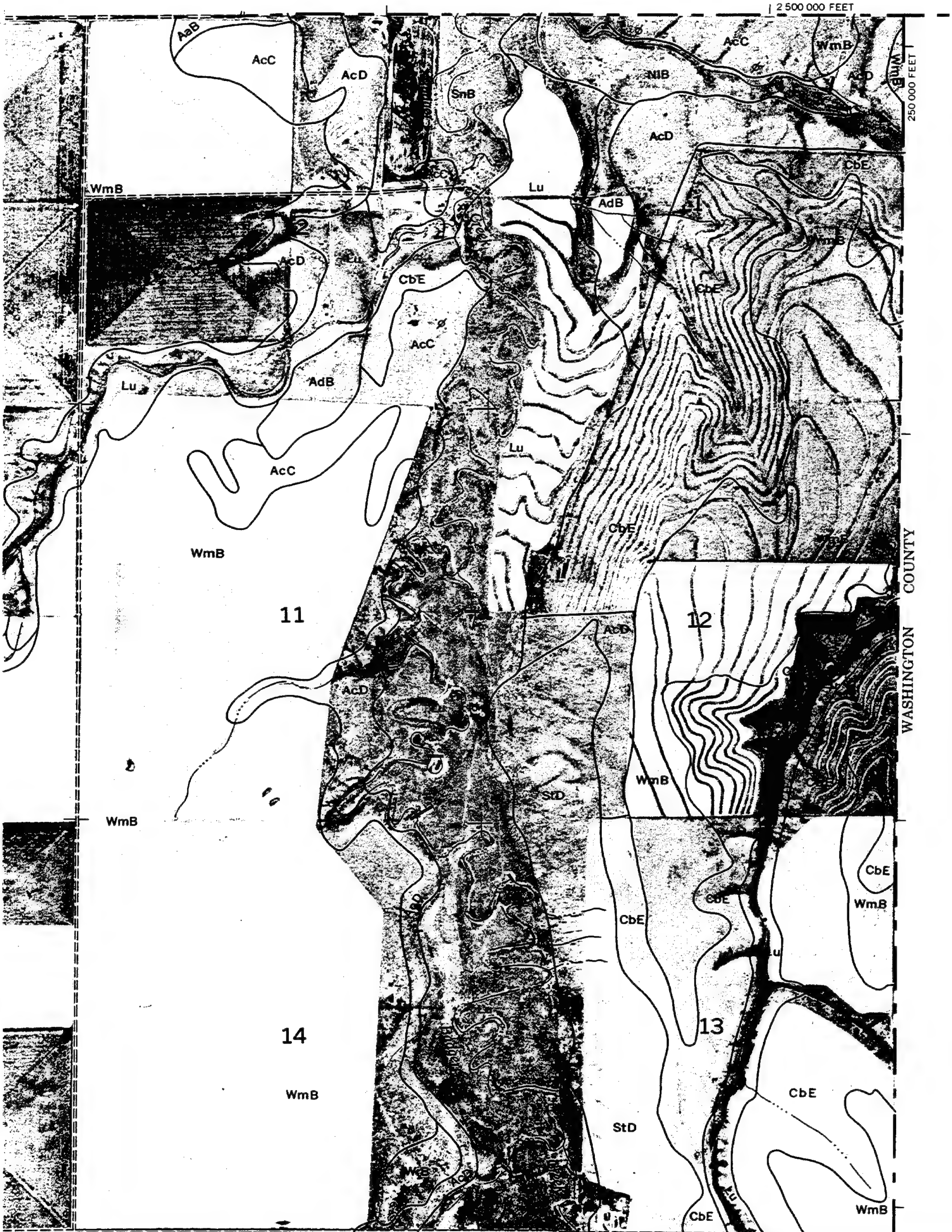


Land division corners are approximately positioned on this map.

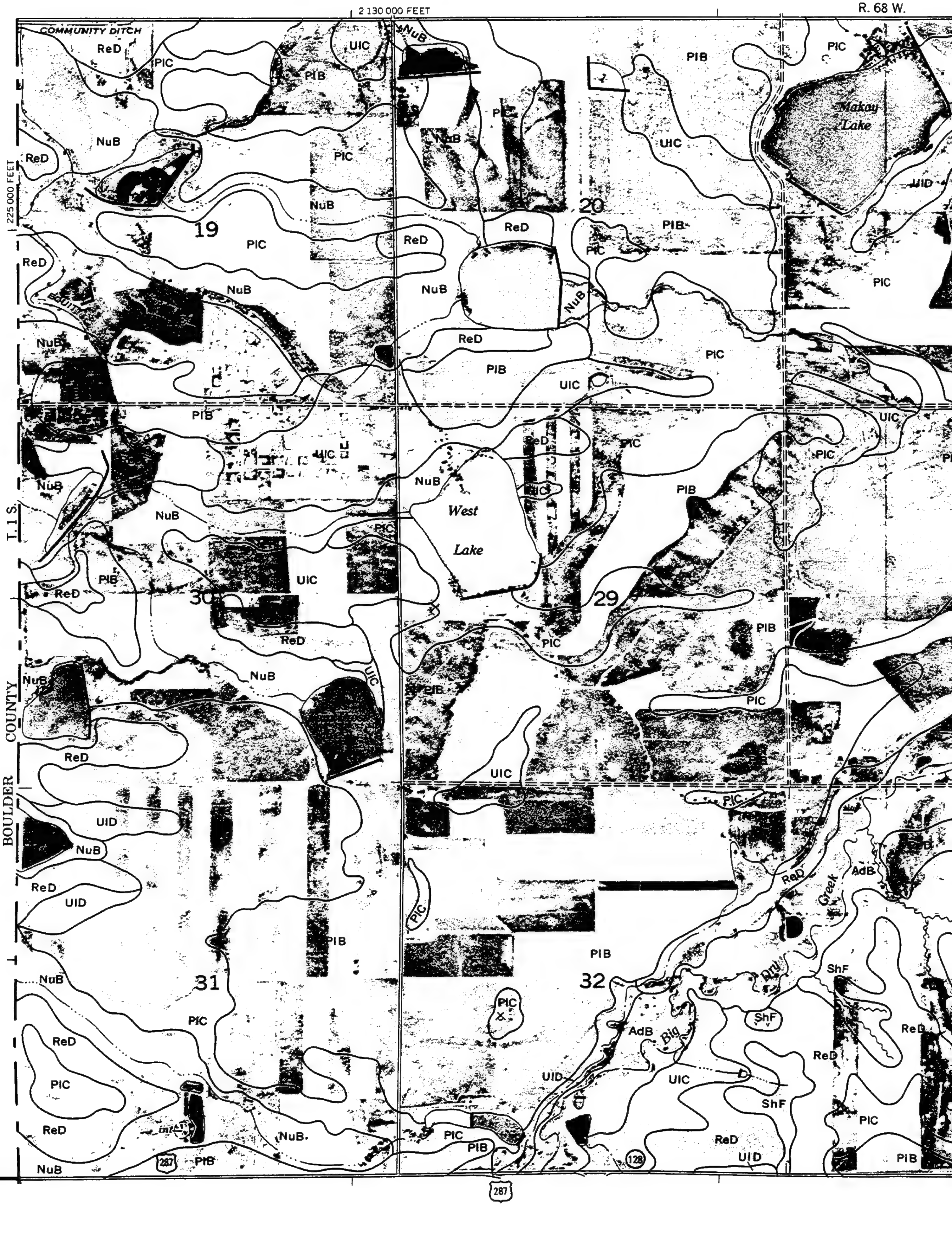

2 455 000 FEET
245 000 FEET
MORGAN COUNTY
T. 1 S.
(Joins sheet 14)
San
Arroyo
WmB
AcC
AcD
CbE
Lu
WuE
AdB
Gu
SrE
int
1
2
3
10
11
12
13
14
15

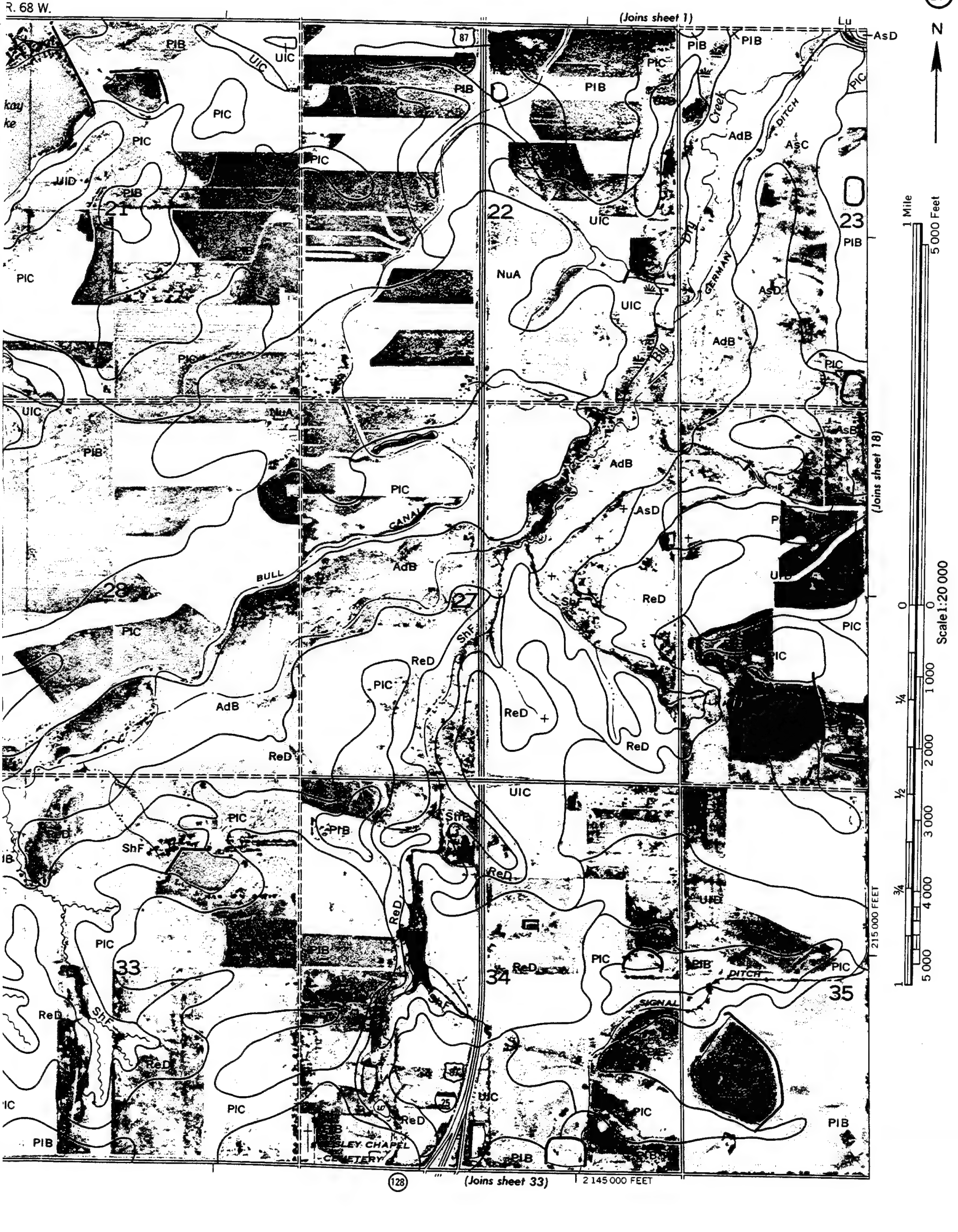

ORGAN COUNTY
R. 58 W.
R. 57 W.
15
N
(Joins sheet 16)
(Joins sheet 31)
2 475 000 FEET
235 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
AcD
AcC
CbE
WuE
WmB
Gu
Lu
SrE
int
1
6
7
8
12
13
17


N
MORGAN COUNTY
R. 57 W.
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 15)
T. 1 S.
235 000 FEET
2 480 000 FEET
(Joins sheet 32)
5
4
9
8
10
11
17
16
15
WmB
WrB
AcC
CbE
AdB
AcD



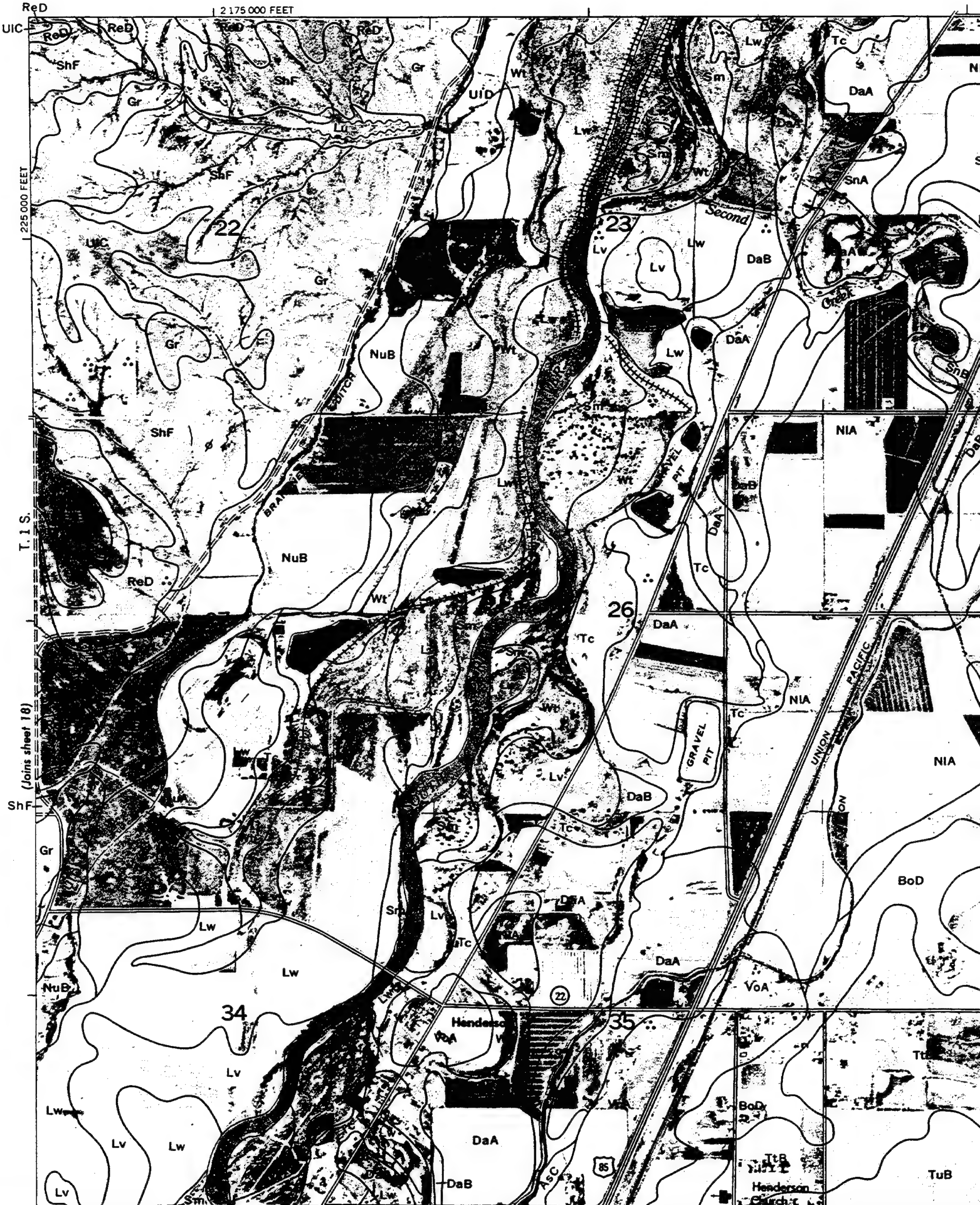
Land division corners are approximately positioned on this map.


2 130 000 FEET
R. 68 W.
225 000 FEET
T. 1 S.
BOULDER COUNTY
COMMUNITY DITCH
Makoy Lake
West Lake
Big Dry Creek
19
20
29
30
31
32
ReD
PIC
PIB
UIC
NuB
UID
AdB
ShF
287
128

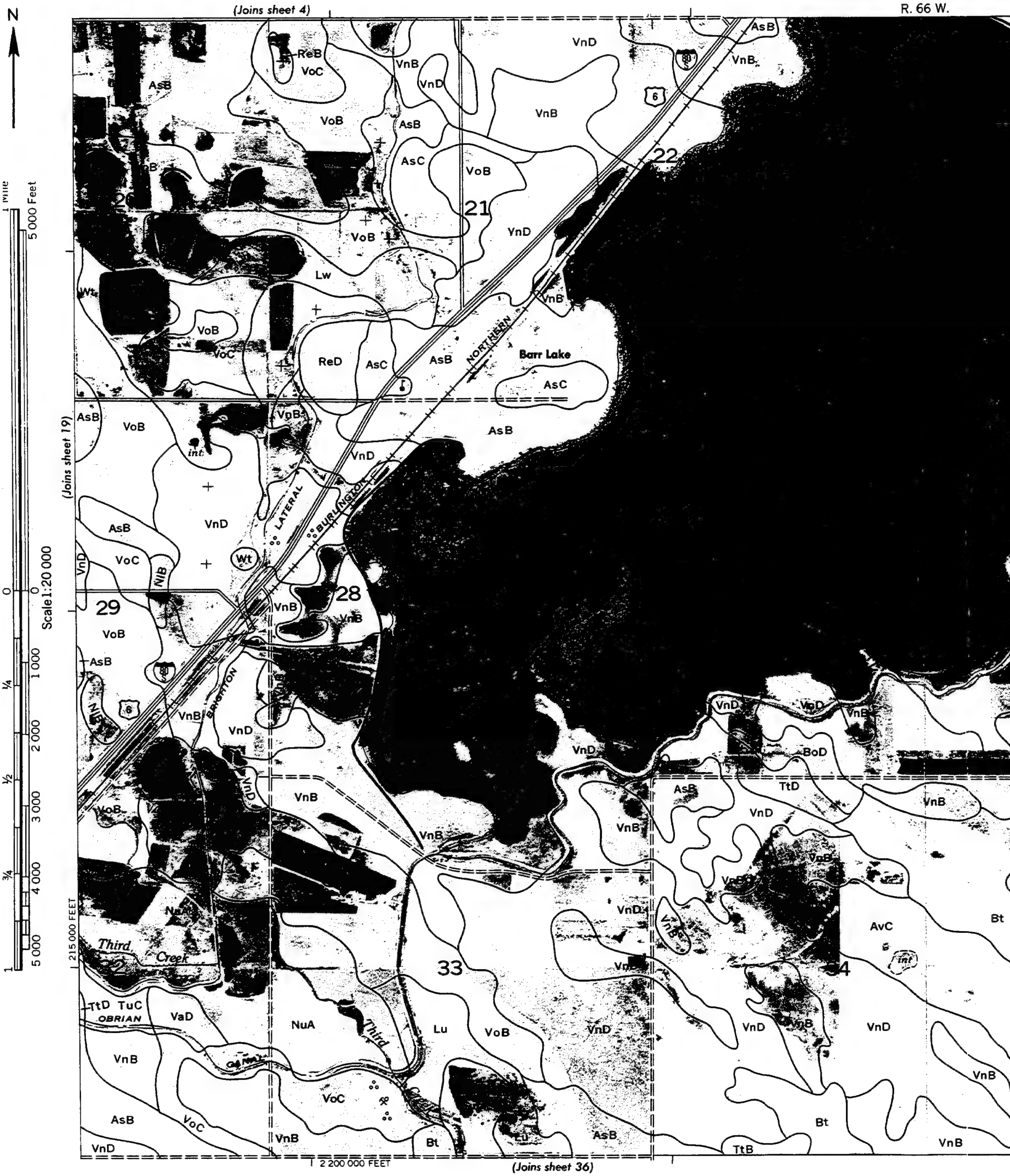

R. 68 W.
(Joins sheet 1)
(Joins sheet 18)
(Joins sheet 33)
2 145 000 FEET
215 000 FEET
N
Scale 1:20 000
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
21
22
23
27
28
33
34
35
87
25
128
PlB
PlC
UlC
UlD
NuA
AdB
AsC
AsD
AsB
ReD
ShF
Lu
Big
Dry
Creek
GERMAN
DITCH
BULL
CANAL
SIGNAL
DITCH
LEY CHAPEL
CEMETERY


N
(Joins sheet 2)
R. 68 W.
R. 67 W.
(Joins sheet 17)
(Joins sheet 34)
Scale 1:20 000
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
215 000 FEET
2 150 000 FEET
23
24
25
26
36
SIGNAL DITCH
UNION PACIFIC
LEE LATERAL
UNION DITCH
Eastlake
Eastlake Res No 1
Lu
AsD
AsC
ReD
UIC
UID
PIC
PIB

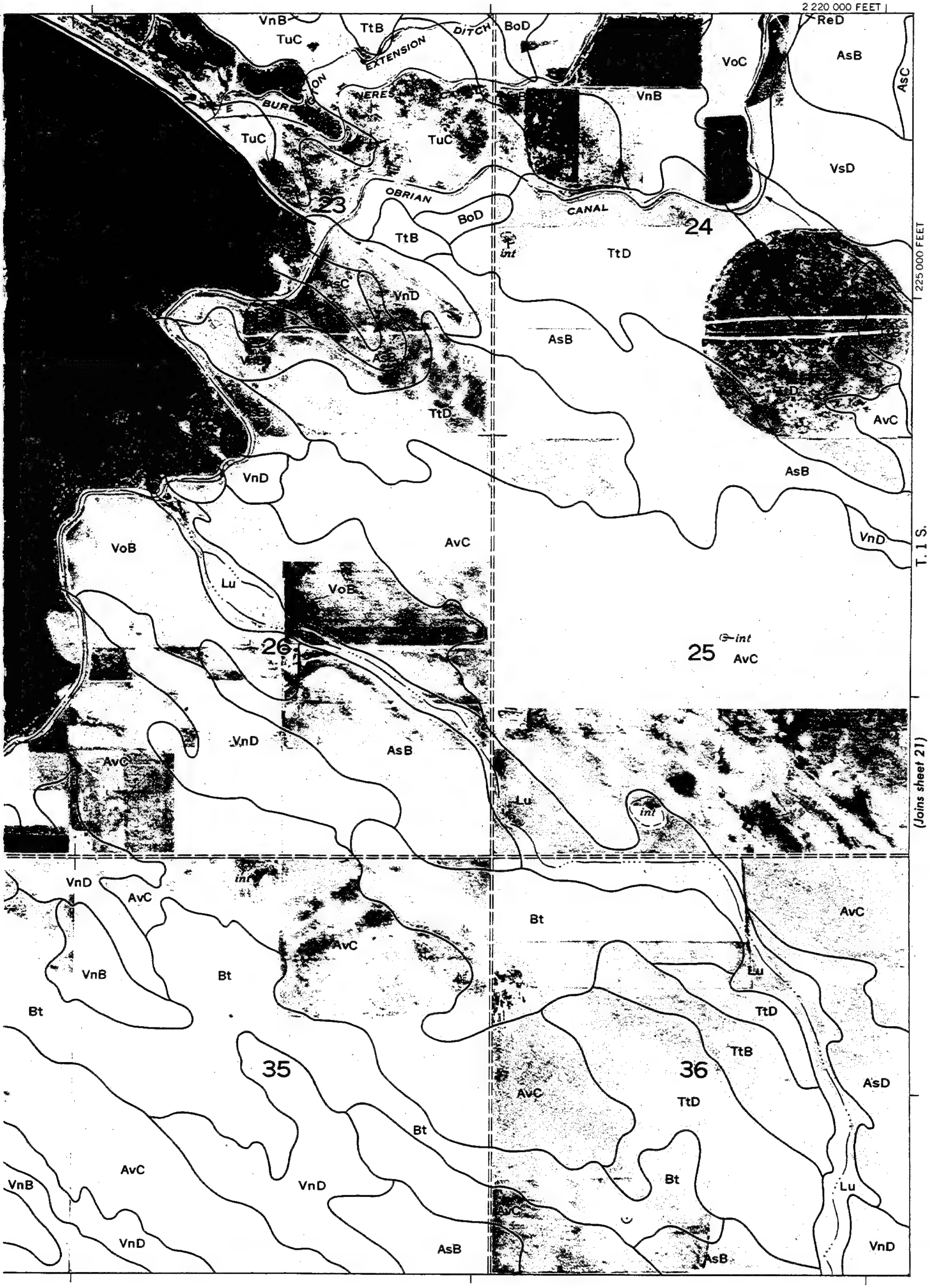
Land division corners are approximately positioned on this map.


2 175 000 FEET
225 000 FEET
T. 1 S.
(Joins sheet 18)
ReD
UIC
ShF
Gr
Lu
UlD
Wt
Lw
Sm
Lv
Tc
DaA
DaB
SnA
SnB
NIA
NuB
BoD
VoA
TtB
TuB
AsC
22
23
26
34
35
Second
Creek
BRANCH
GRAVEL PIT
UNION PACIFIC
Henderson
Henderson Church
85

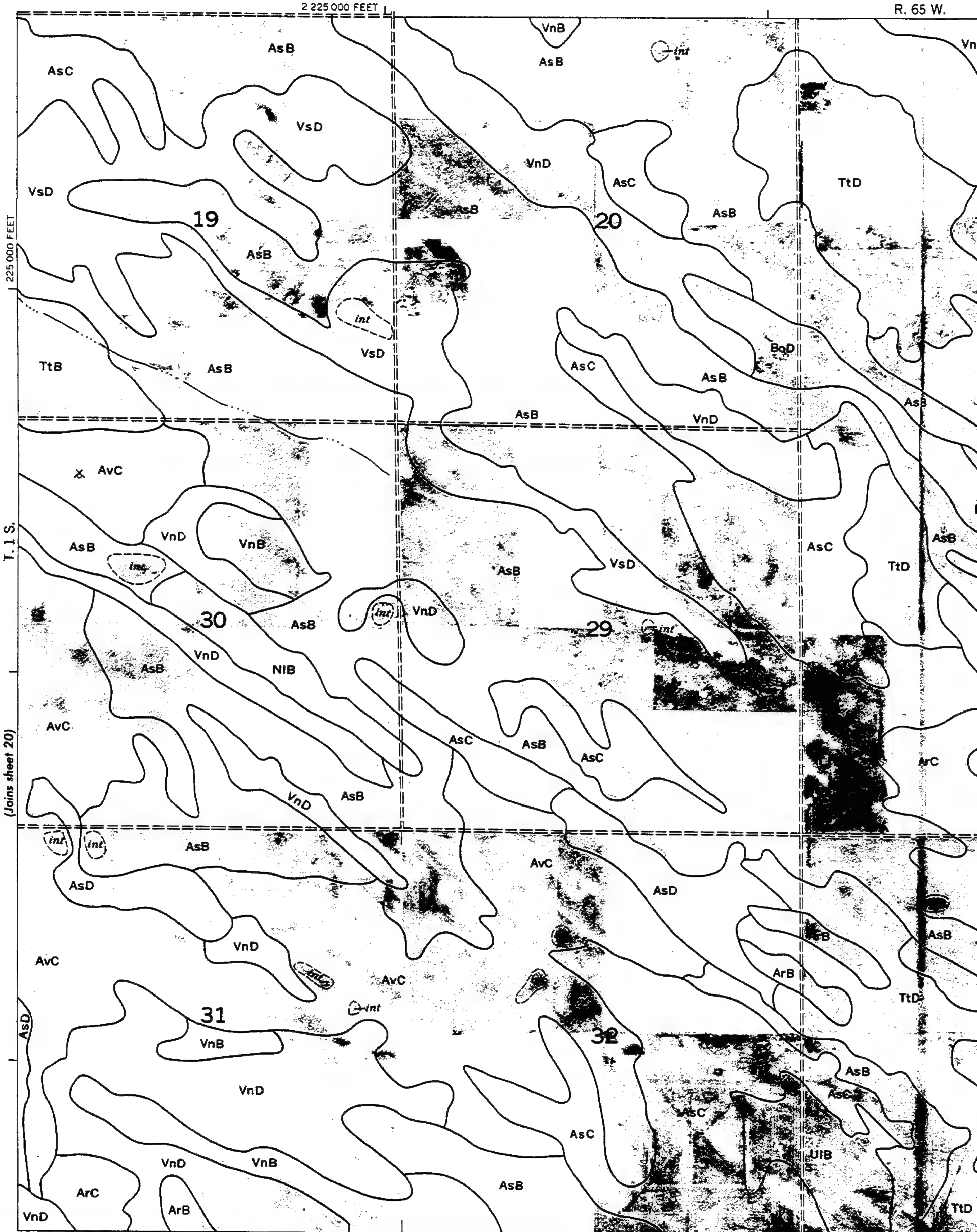

R. 67 W.
R. 66 W.
(Joins sheet 3)
(Joins sheet 20)
(Joins sheet 35)
N
1 Mile
5 000 Feet
0
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000
215 000 FEET
2 195 000 FEET
24
19
20
25
30
29
36
32
NlA
SnB
DaA
NuA
TtB
AsB
ArB
VoB
BoD
TuC
SnA
DaB
VoC
FULTON
LATERAL
NuB
AsC
Third
NuA
VnD
VoC
VnD
VoB
BoD
TtD
BoD
Second
TtB
TuC
VoC
6
70
OBRIAN
TtD
VnB
VnD
VnD
AsB
VoB
SnA
TuC
TuB
TtB
TuB


N
(Joins sheet 4)
R. 66 W.
(Joins sheet 19)
(Joins sheet 36)
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
215 000 FEET
2 200 000 FEET
Barr Lake
NORTHERN
BURLINGTON
BRIGHTON
LATERAL
Third Creek
OBRIAN
Third
21
22
28
29
33
34
AsB
AsC
ReB
ReD
VoB
VoC
VnB
VnD
Lw
Wt
NlB
int.
BoD
TtD
TtB
TuC
AvC
Bt
VaD
NuA
Lu
6
80

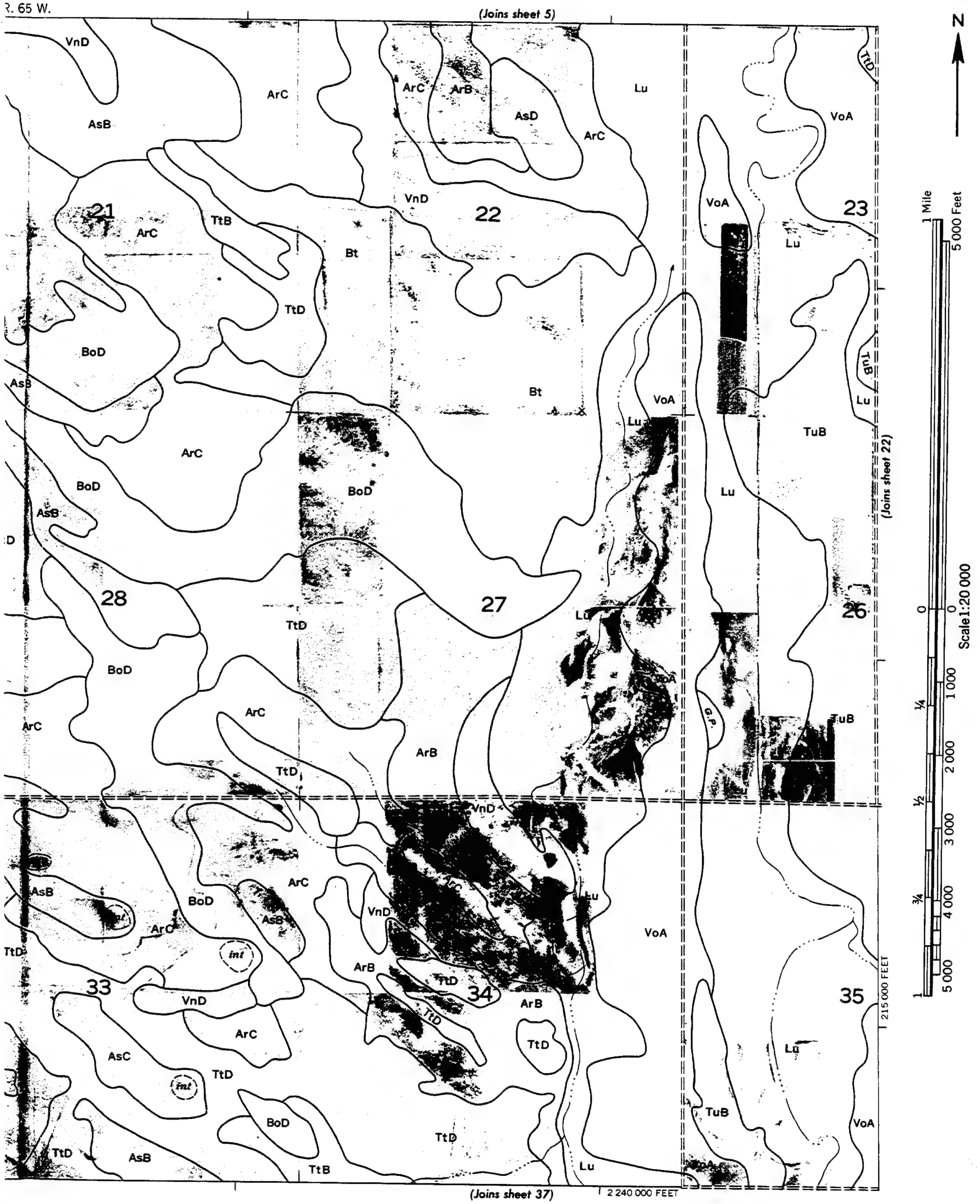
SHEET NUMBER 20

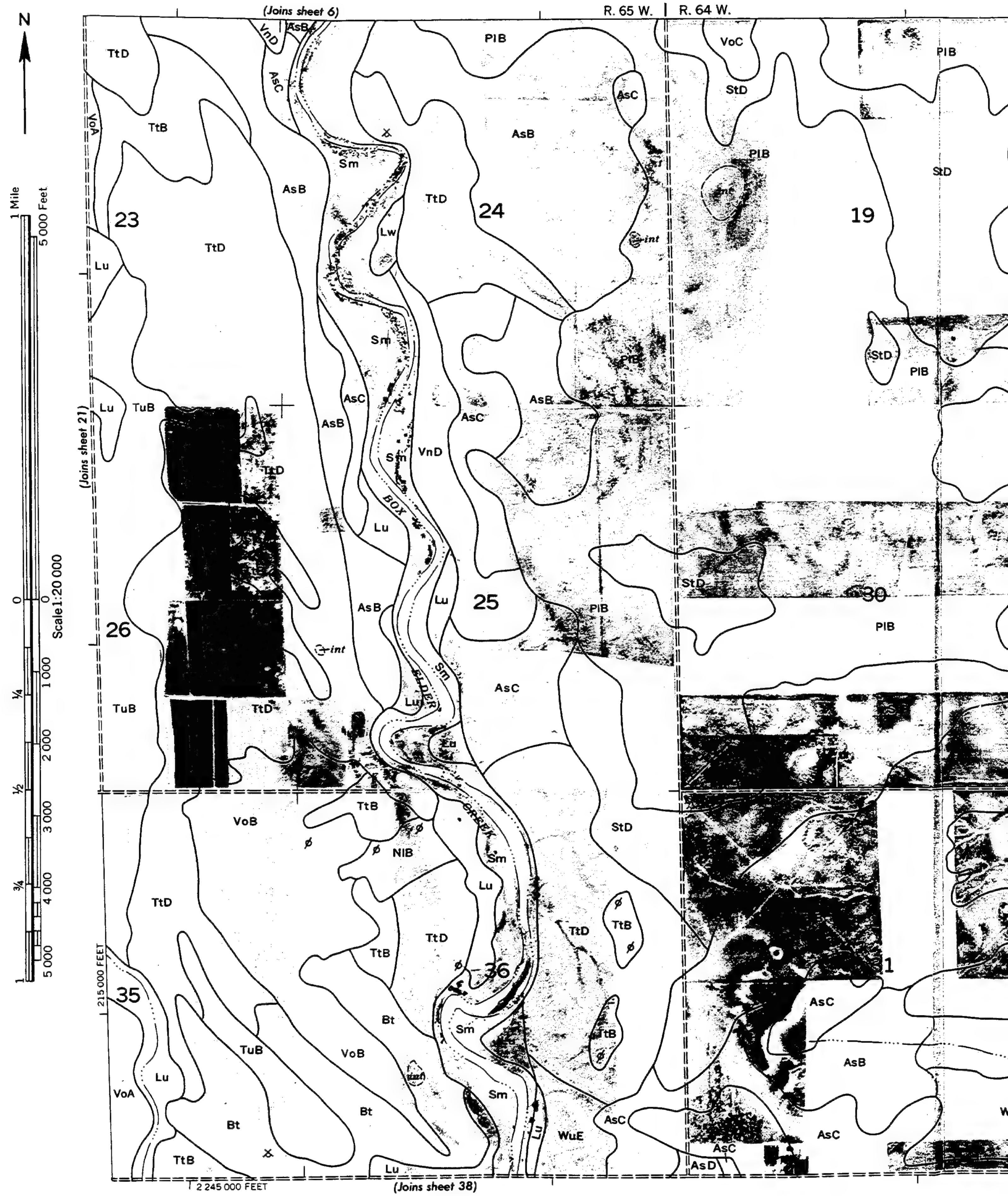


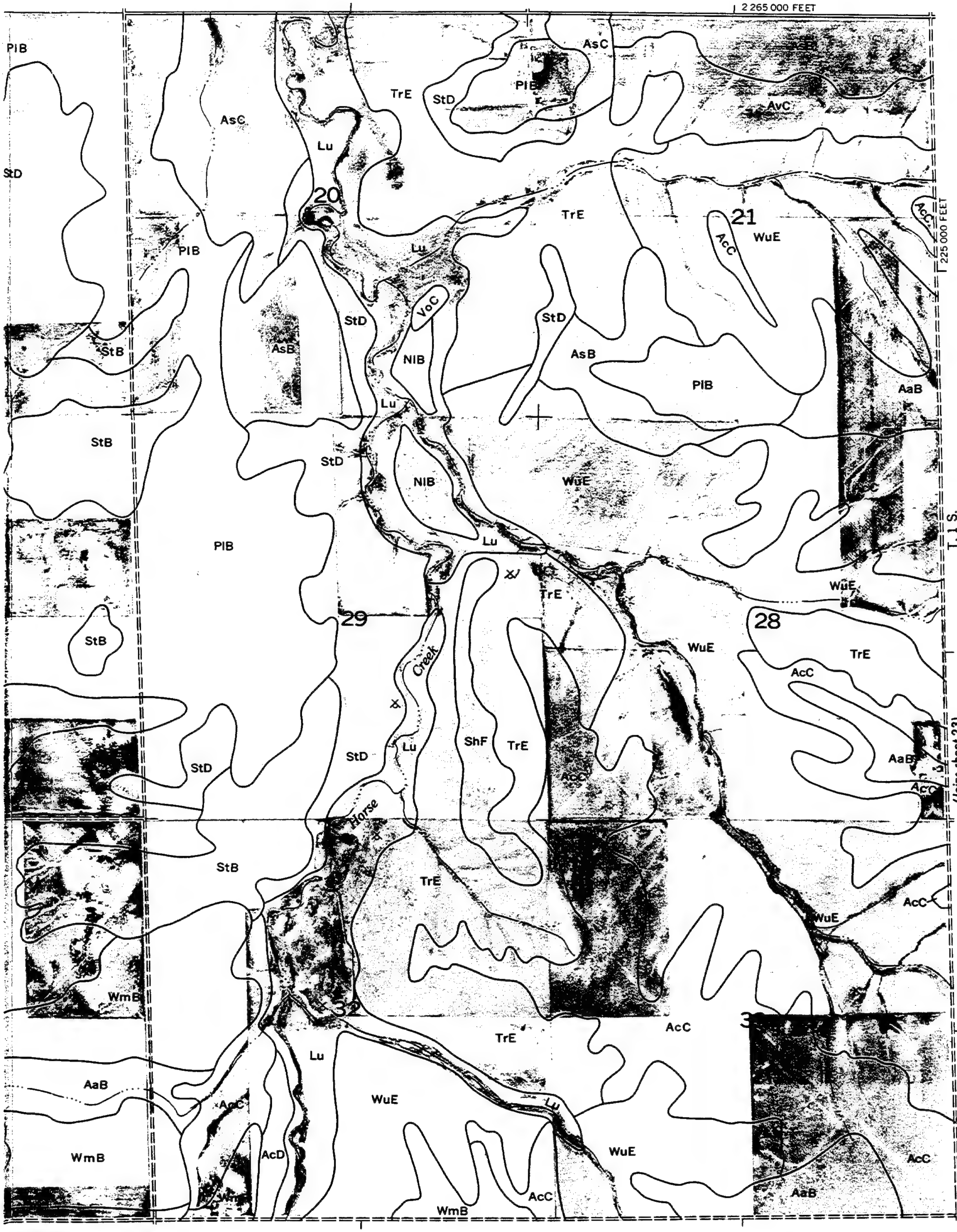
Land division corners are approximately positioned on this map.


2 225 000 FEET
R. 65 W.
225 000 FEET
T. 1 S.
(Joins sheet 20)
19
20
29
30
31
32
AsB
AsC
AsD
ArB
ArC
AvC
BoD
NIB
TtB
TtD
UIB
VnB
VnD
VsD
int

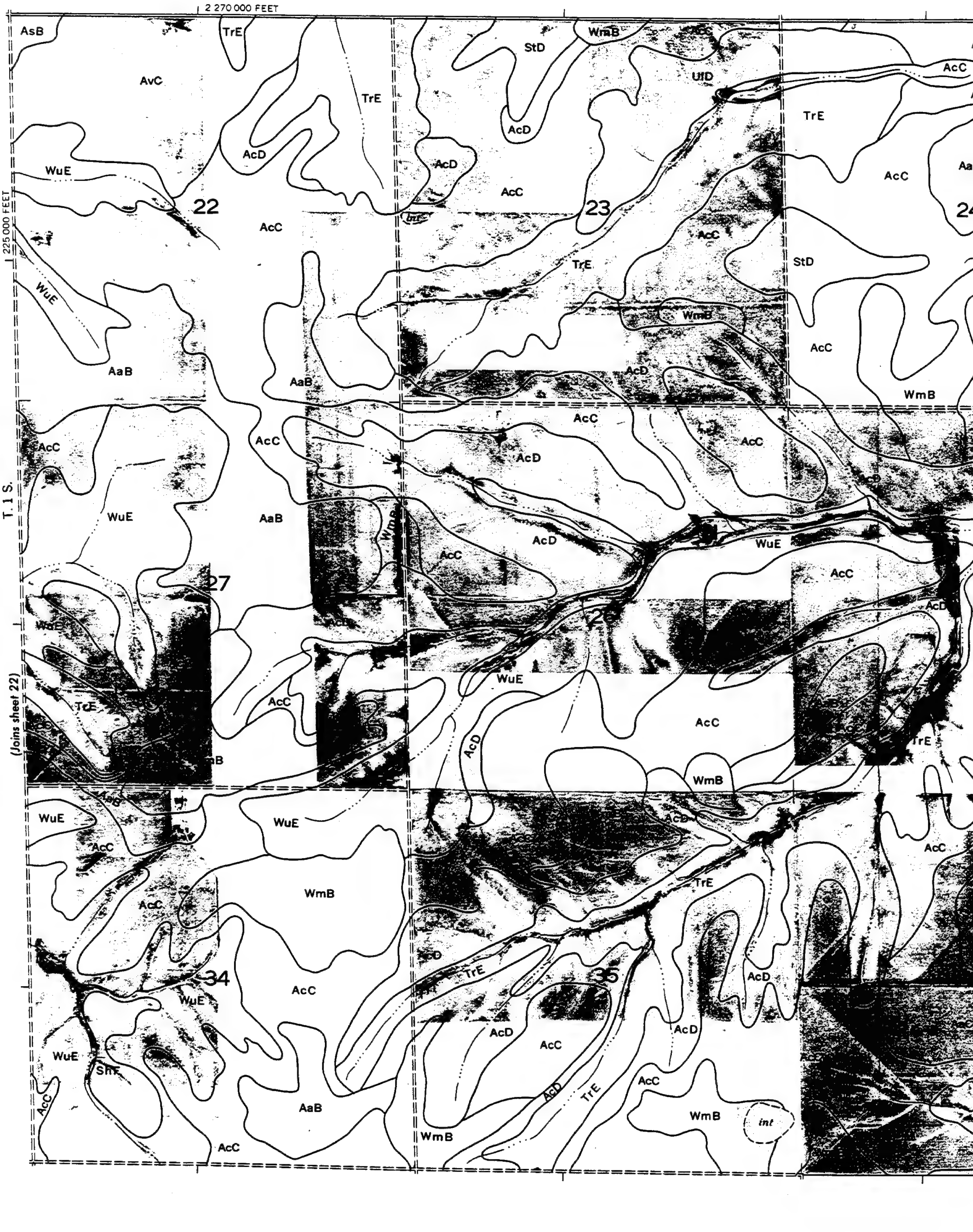
(21)

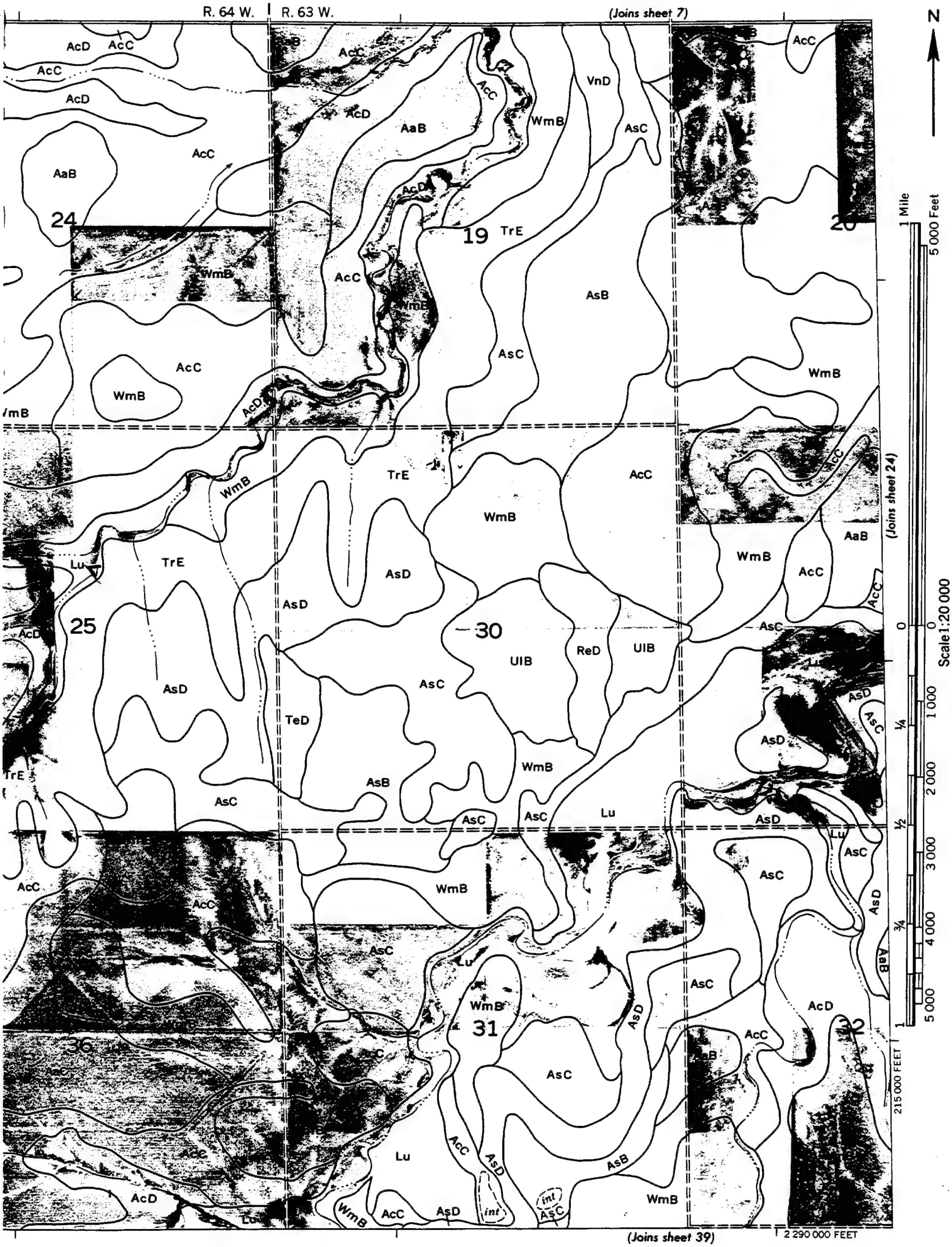

R. 65 W.
(Joins sheet 5)
(Joins sheet 22)
(Joins sheet 37)
2 240 000 FEET
215 000 FEET
N
21
22
23
26
27
28
33
34
35
VnD
AsB
ArC
ArB
AsD
Lu
VoA
TtD
TtB
Bt
BoD
TuB
AsC
G.P.
int
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000


N
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
1
(Joins sheet 6)
(Joins sheet 21)
(Joins sheet 38)
R. 65 W.
R. 64 W.
215 000 FEET
2 245 000 FEET
23
24
19
26
25
30
35
36
31
BOX ELDER CREEK
TtD
TtB
VoA
VnD
AsB
AsC
PlB
VoC
StD
Sm
Lw
Lu
TuB
VnD
int
NlB
VoB
TtB
Bt
WuE
AsD



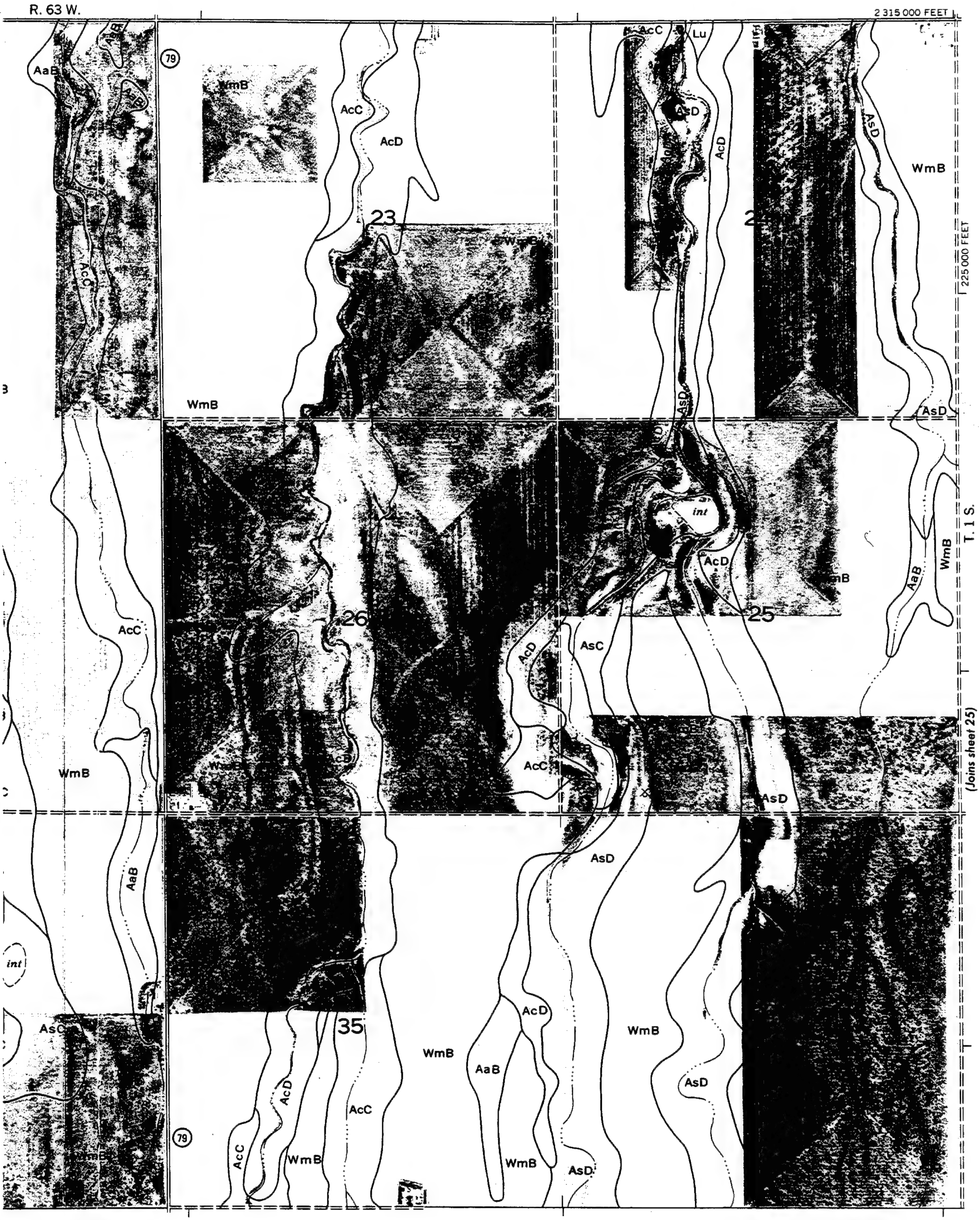
Land division corners are approximately positioned on this map.

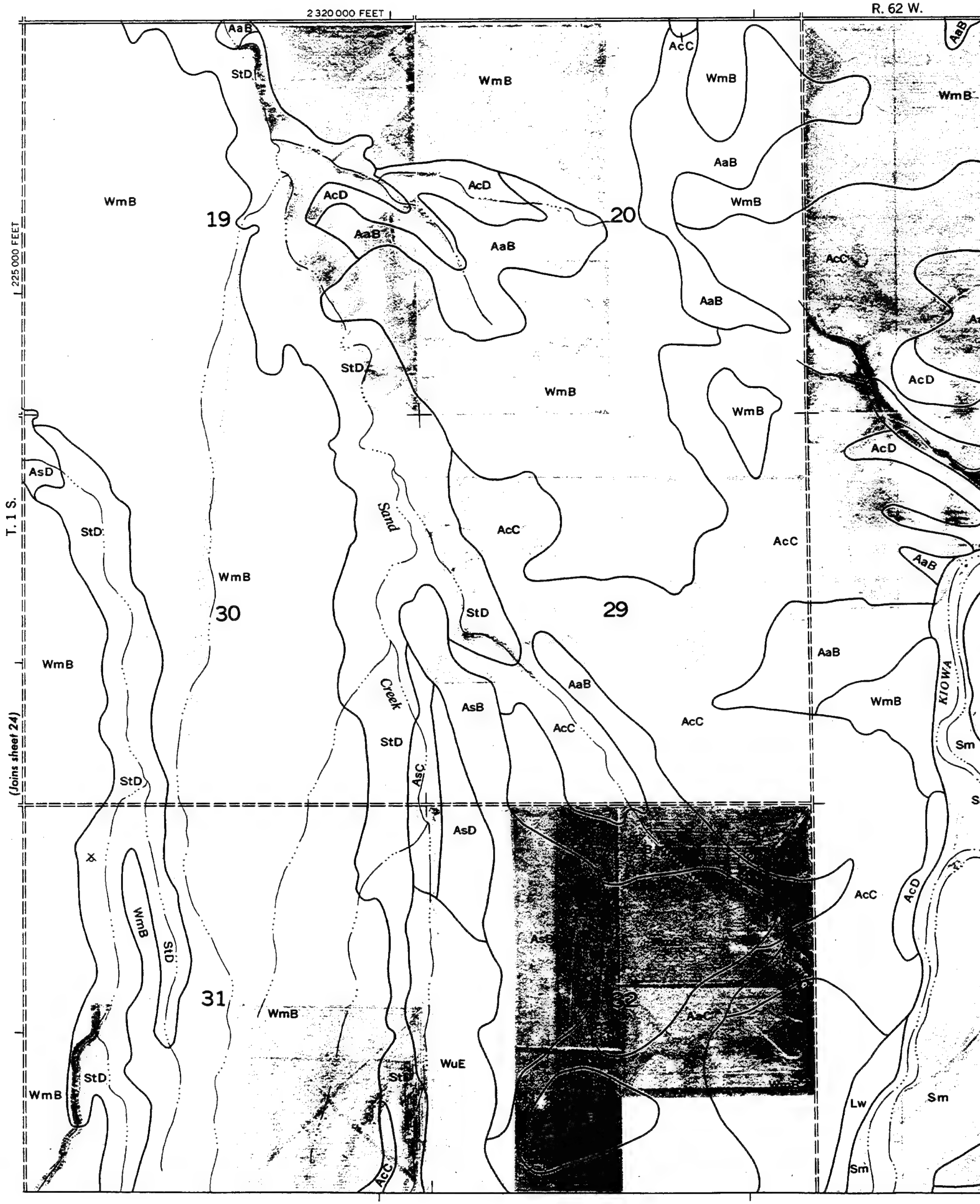

2 270 000 FEET
225 000 FEET
T. 1 S.
(Joins sheet 22)
22
23
24
27
26
34
35
AsB
TrE
AvC
WmB
StD
AcC
UfD
AcD
WuE
AaB
TrE
WmB
ShF
AcC
int


23
N
R. 64 W.
R. 63 W.
(Joins sheet 7)
(Joins sheet 24)
(Joins sheet 39)
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
215 000 FEET
2 290 000 FEET
19
20
24
25
30
31
32
36
AcD
AcC
AaB
WmB
VnD
AsC
AsB
TrE
AsD
ReD
UlB
TeD
Lu
AcD
int


N
(Joins sheet 8)
R. 63 W.
(Joins sheet 23)
(Joins sheet 40)
2 295 000 FEET
215 000 FEET
Scale 1:20 000
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000
20
21
22
27
28
33
34
Lost
Creek
AsB
StD
Sm
AsC
AcC
WmB
PlB
Lu
int
AsD
ArC
AaB
AcD
VoB

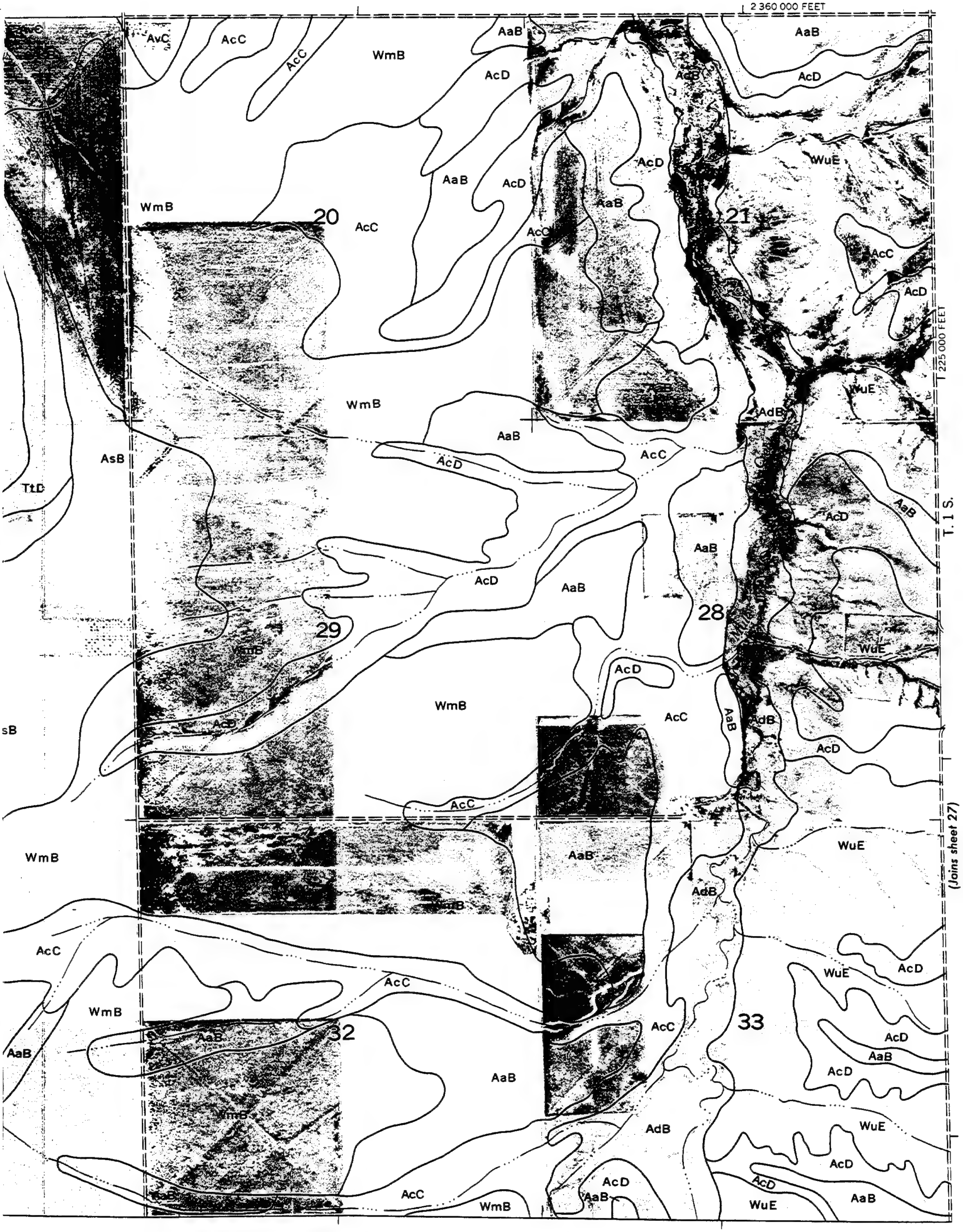
LORADO — SHEET NUMBER 24



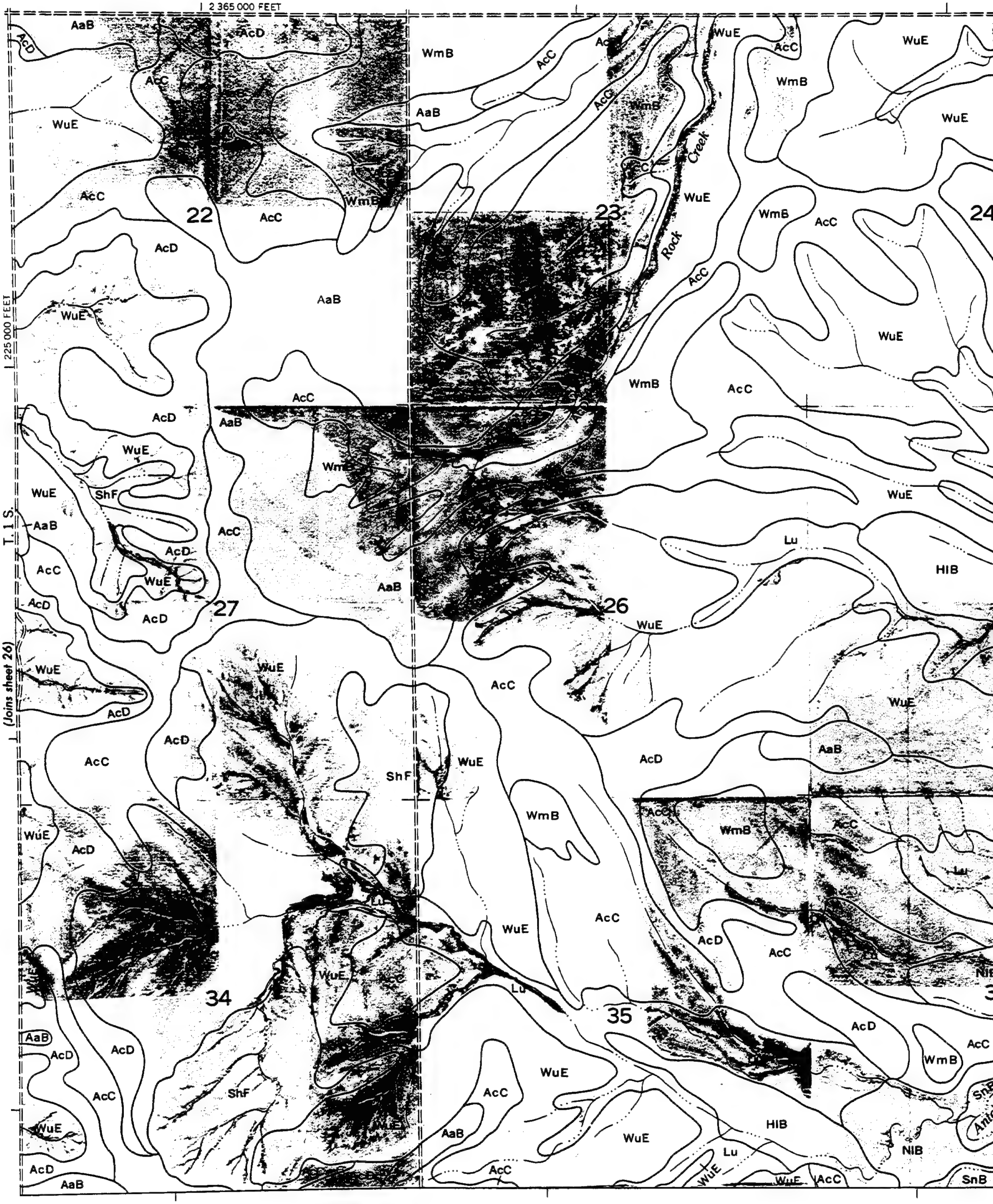

2 320 000 FEET
R. 62 W.
225 000 FEET
T. 1 S.
(Joins sheet 24)
19
20
29
30
31
32
Sand
Creek
KIOWA
AaB
StD
AcC
WmB
AcD
AsD
AsB
AsC
WuE
Sm
Lw

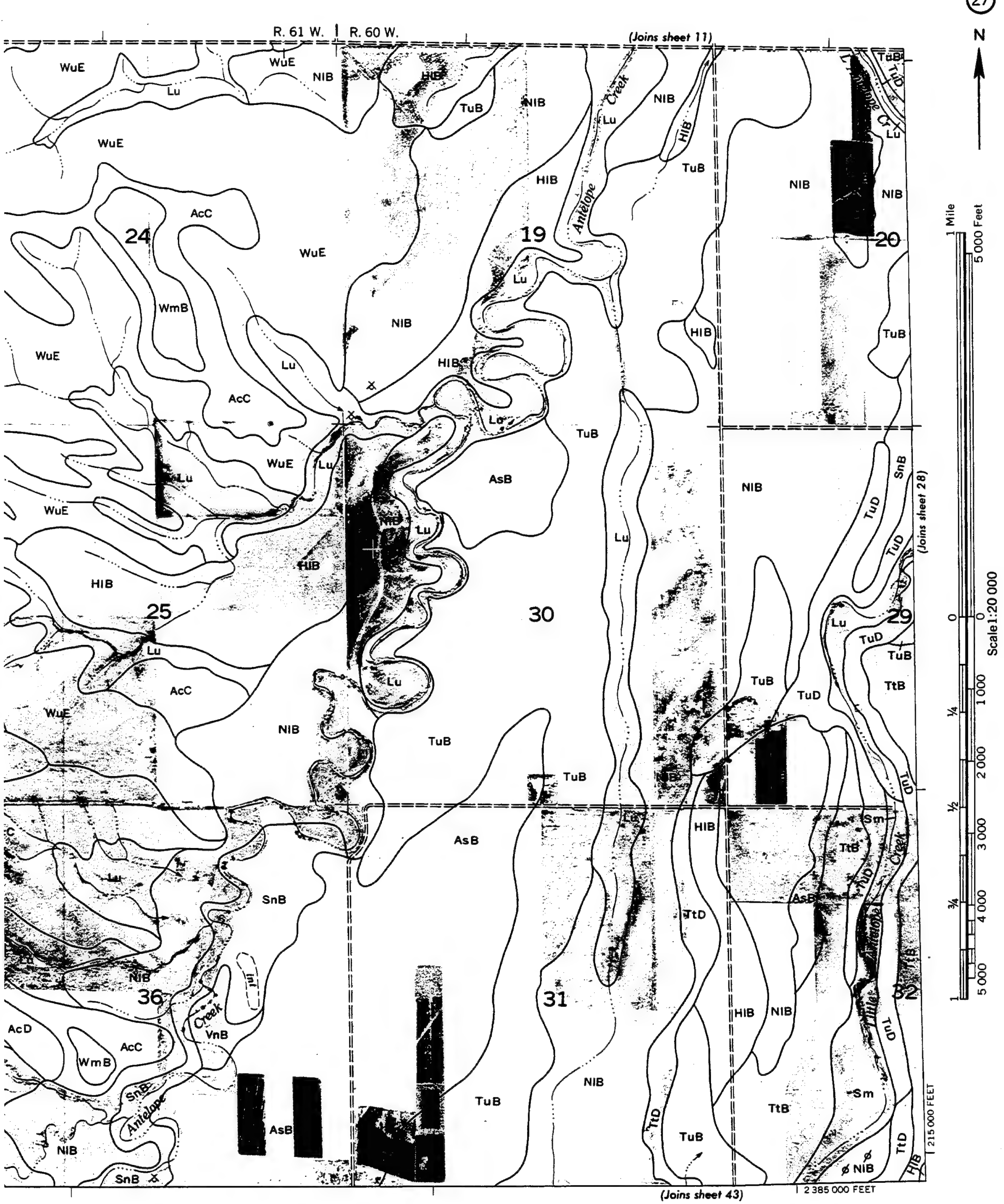

R. 62 W.
(Joins sheet 9)
N
AaB
AcC
WmB
AcC
WmB
AsB
NIB
Lw
Lw
GRAVEL PIT
AsB
VnD
NIA
Lw
21
22
Lw
AsB
VnD
AsB
AaB
AcD
AcC
AcD
Lw
NIA
VoB
VnD
Lw
(Joins sheet 26)
Sm
CREEK
Sm
Sm
AaB
Lw
AsB
AdB
HIB
HID
VoB
Lw
28
AsC
27
26
AdB
WmB
KIOWA
HID
VnD
HIB
Sm
Sm
AsB
Lu
WmB
VoB
AsC
PIC
AcD
AcD
cC
PIB
AsC
AsB
Lu
AaB
33
Sm
Lw
AsB
34
Sm
Lw
AsB
AsD
Lu
AcD
AsC
PIC
Lw
VoB
AsC
WmB
PIB
PIB
Lw
AsB
NIB
ArB
(Joins sheet 41)
2 335 000 FEET
215 000 FEET
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000

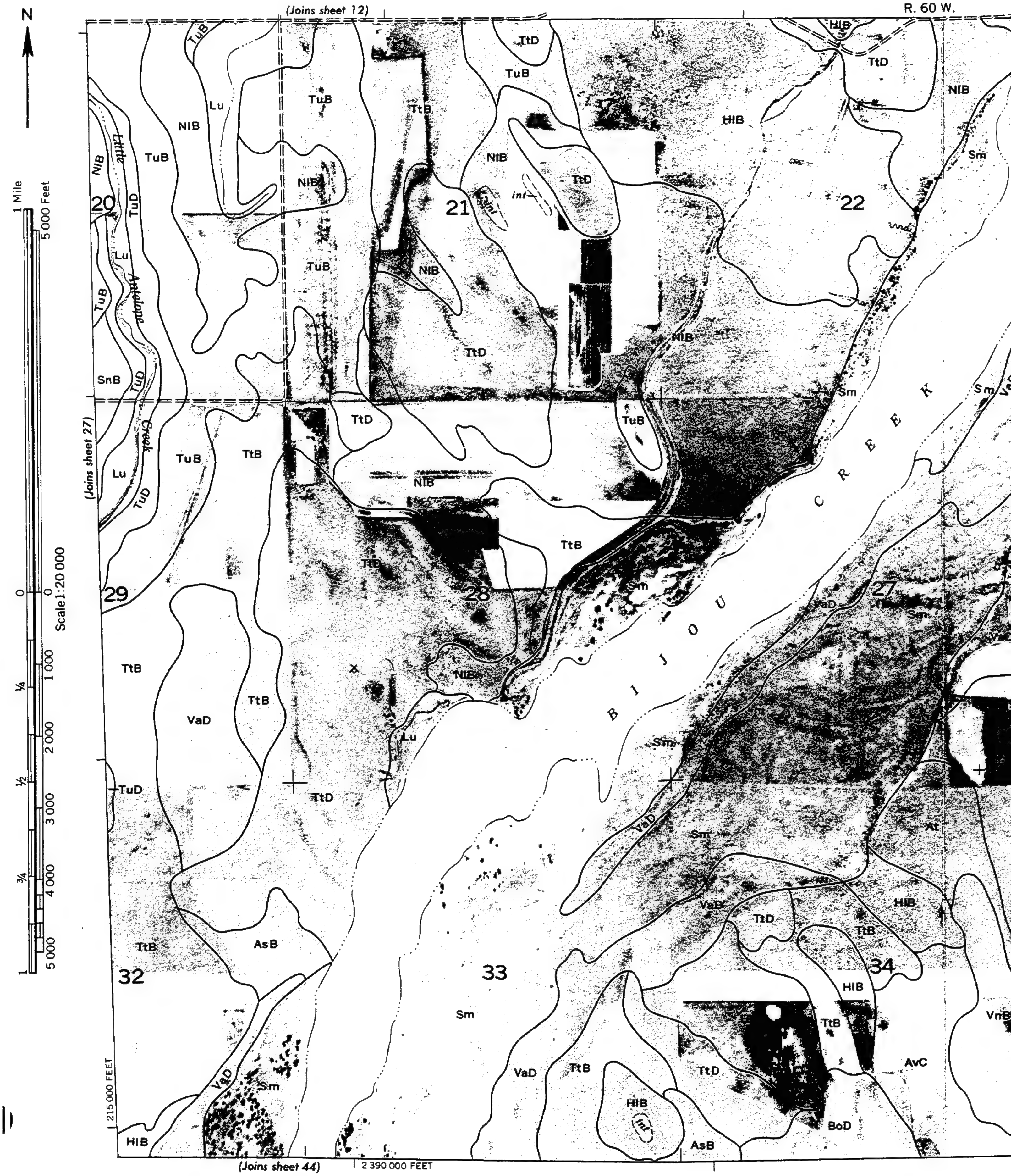

N
5 000 Feet
Scale 1:20 000
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 10)
(Joins sheet 25)
(Joins sheet 42)
R. 62 W.
R. 61 W.
215 000 FEET
2 340 000 FEET
Comanche
Creek
23
24
25
26
19
30
31
35
36
NIA
VoB
Lw
Sm
AcD
AvC
NIB
VnD
AsB
TtD
AdB
AcC
Lu
int
WmB
VnB
StD
StB
VaD
AaB
Wt



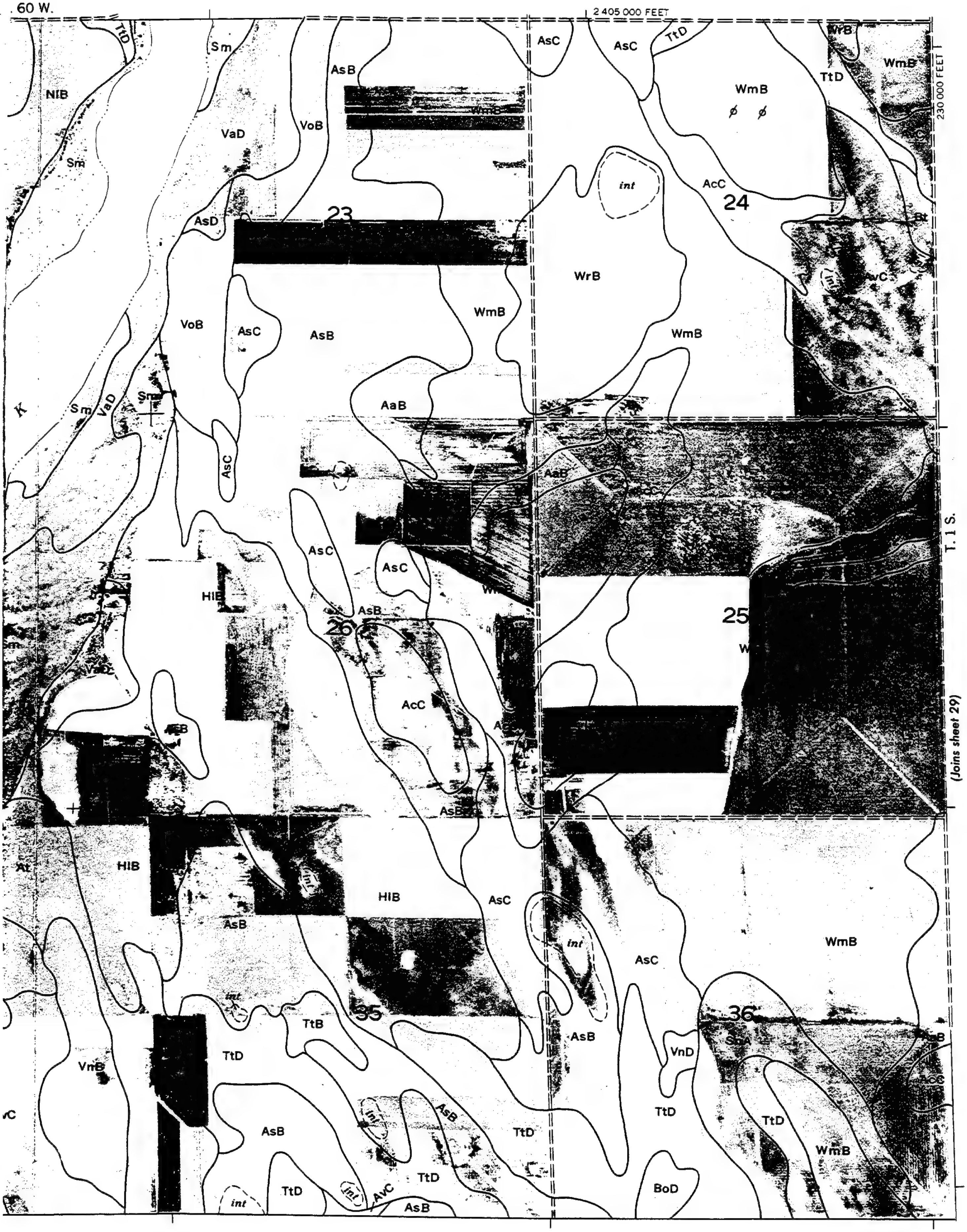
Land division corners are approximately positioned on this map

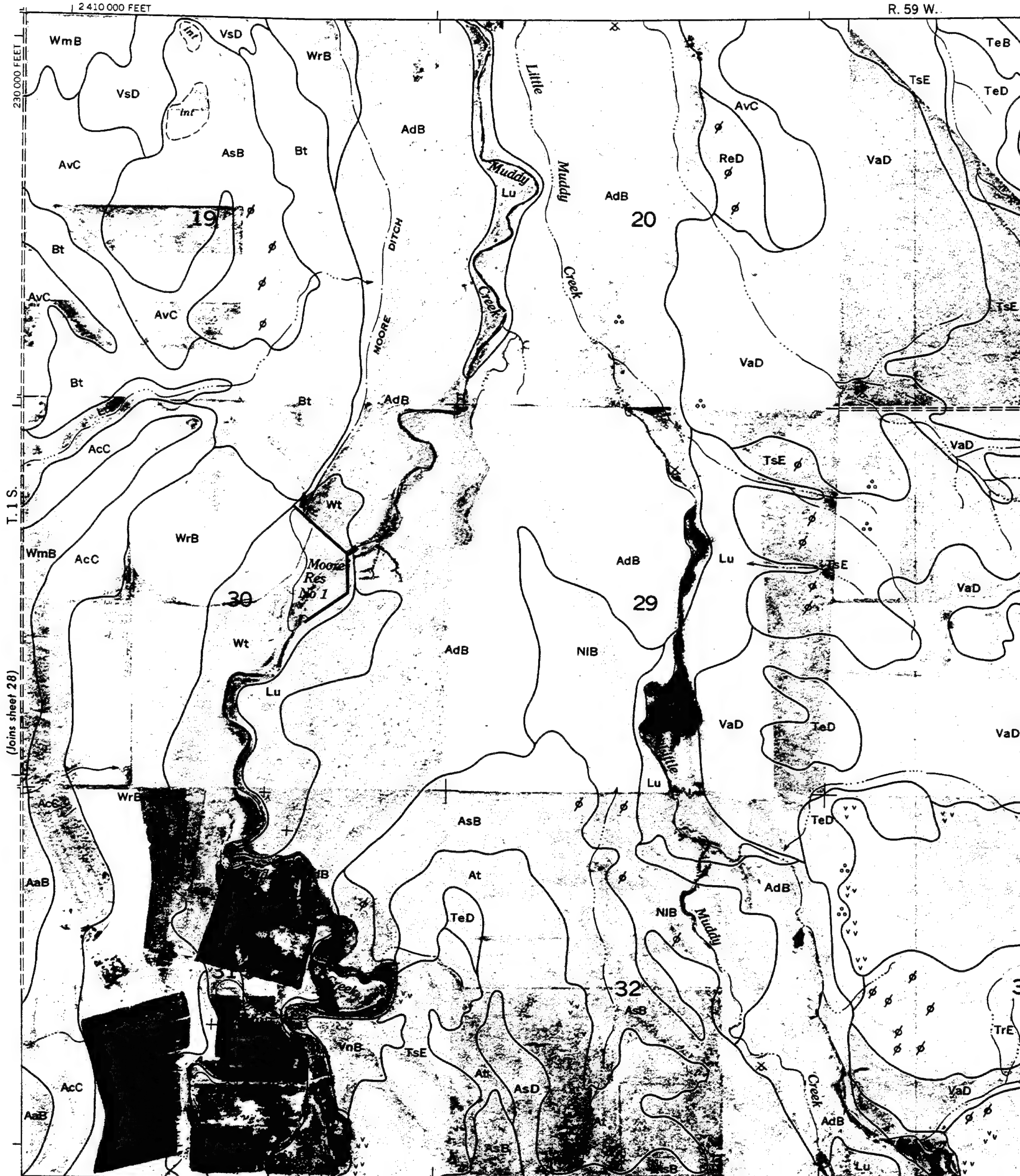

2 365 000 FEET
225 000 FEET
T. 1 S.
(Joins sheet 26)
22
23
24
26
27
34
35
Rock
Creek
AaB
AcC
AcD
AcG
WmB
WuE
ShF
Lu
HlB
NlB
SnB

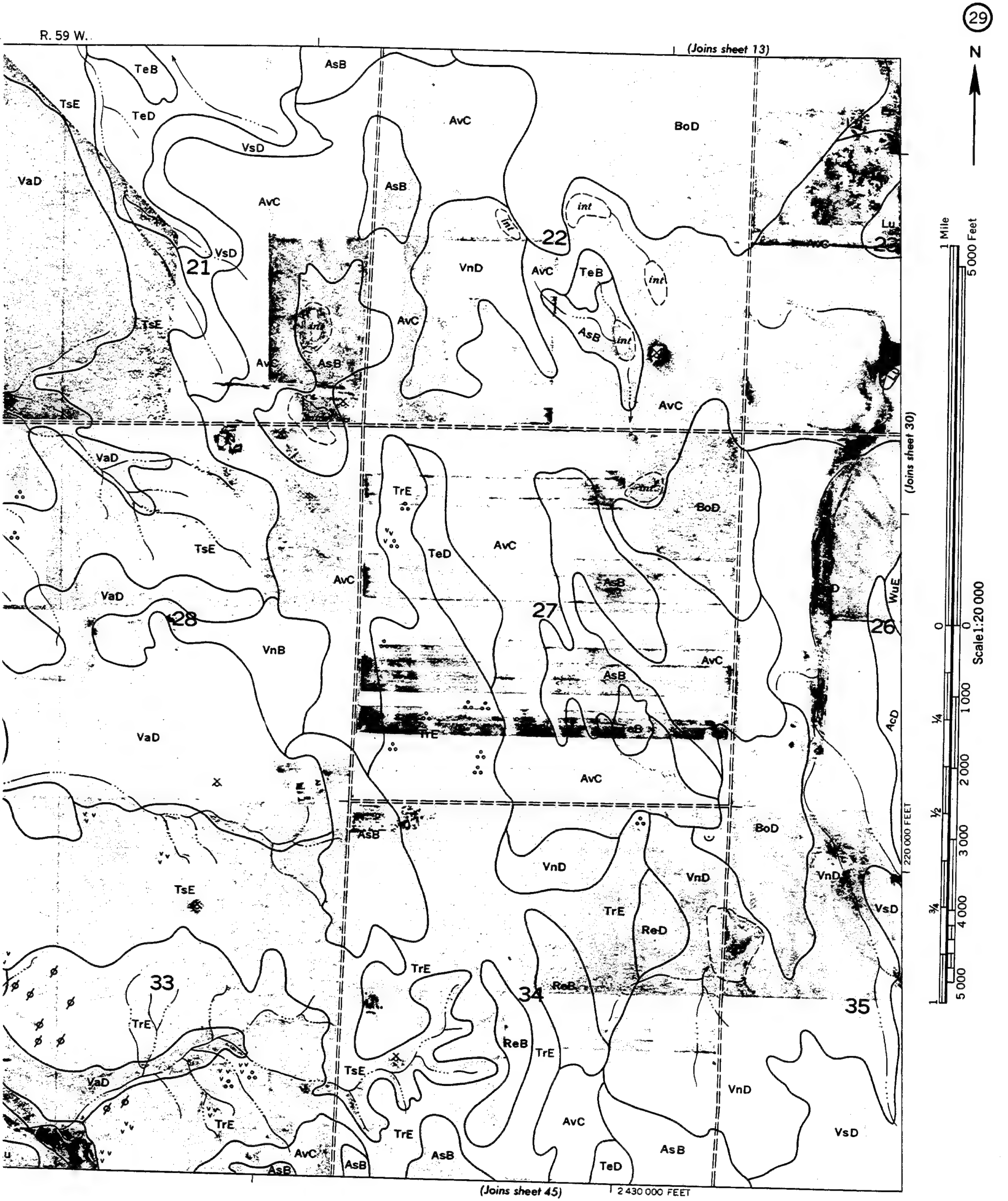

27
N
R. 61 W.
R. 60 W.
(Joins sheet 11)
(Joins sheet 28)
(Joins sheet 43)
WuE
Lu
NlB
HlB
TuB
TuD
Antelope Creek
AcC
WmB
AsB
SnB
TtB
TtD
Sm
AcD
VnB
Inl
Little Antelope Creek
19
20
24
25
29
30
31
32
36
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
215 000 FEET
2 385 000 FEET

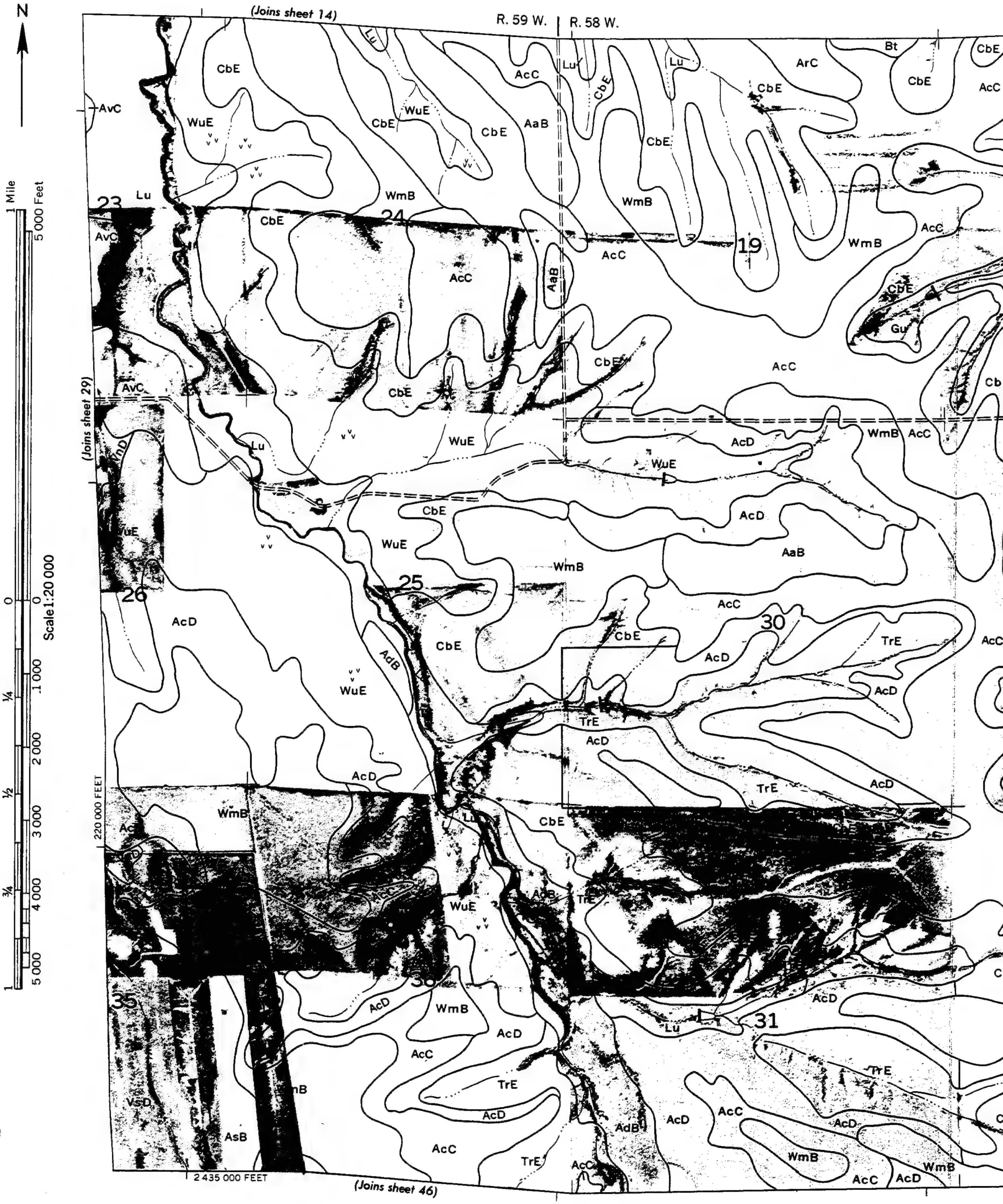

N
1 Mile
5 000 Feet
0
0
1/4
1 000
2 000
1/2
3 000
3/4
4 000
5 000
1
5 000
Scale 1:20 000
(Joins sheet 12)
R. 60 W.
(Joins sheet 27)
(Joins sheet 44)
2 390 000 FEET
215 000 FEET
Little Antelope Creek
BIJOU CREEK
20
21
22
27
28
29
32
33
34
TuB
TtD
HlB
NlB
Lu
TtB
Sm
int
SnB
TuD
VaD
AsB
At
VnB
AvC
BoD

RADO — SHEET NUMBER 28

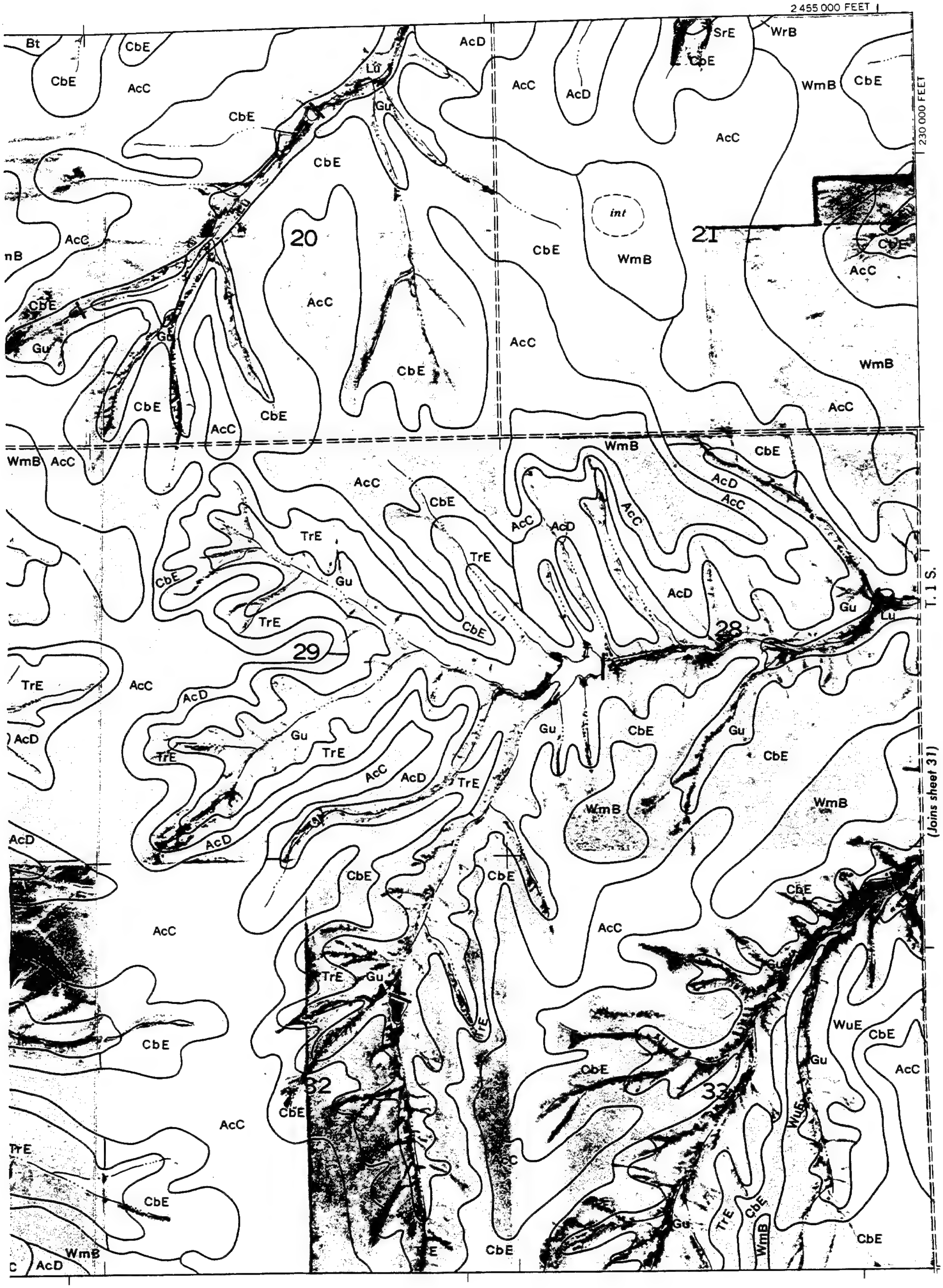


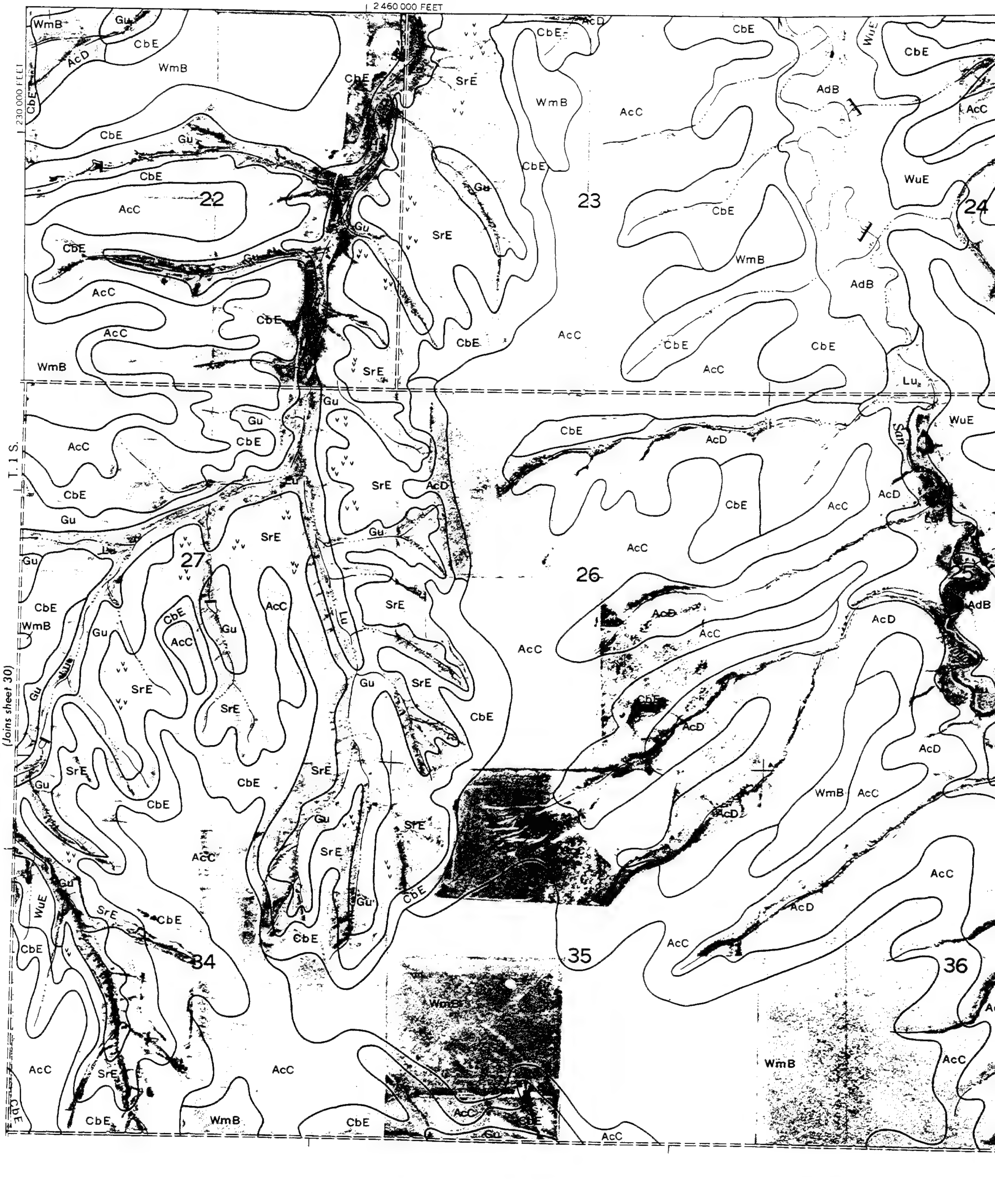

2 410 000 FEET
230 000 FEET
R. 59 W.
T. 1 S.
(Joins sheet 28)
WmB
VsD
WrB
AdB
AsB
Bt
AvC
19
20
29
30
32
Little Muddy Creek
Muddy Creek
MOORE DITCH
Moore Res No 1
Lu
Wt
AcC
NIB
VaD
TsE
ReD
TeB
TeD
At
AaB
VnB
AsD
TrE
Int

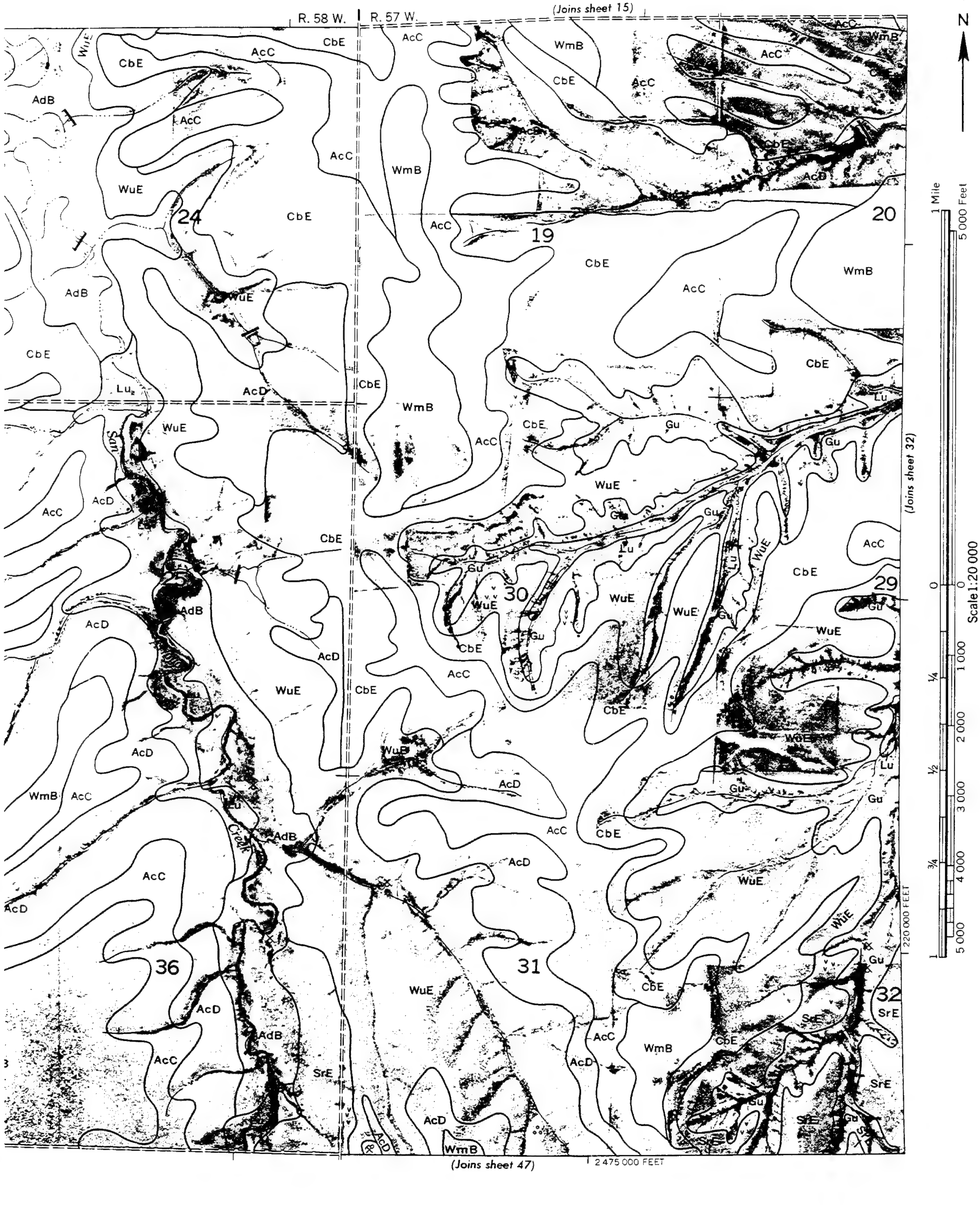

29
N
R. 59 W.
(Joins sheet 13)
(Joins sheet 30)
(Joins sheet 45)
2 430 000 FEET
220 000 FEET
21
22
23
26
27
28
33
34
35
TeB
TsE
TeD
VsD
VaD
AvC
AsB
BoD
VnD
TeB
int
Lu
TrE
TeD
VnB
WuE
AcD
ReD
ReB
Scale 1:20 000
1 Mile
5 000 Feet
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000

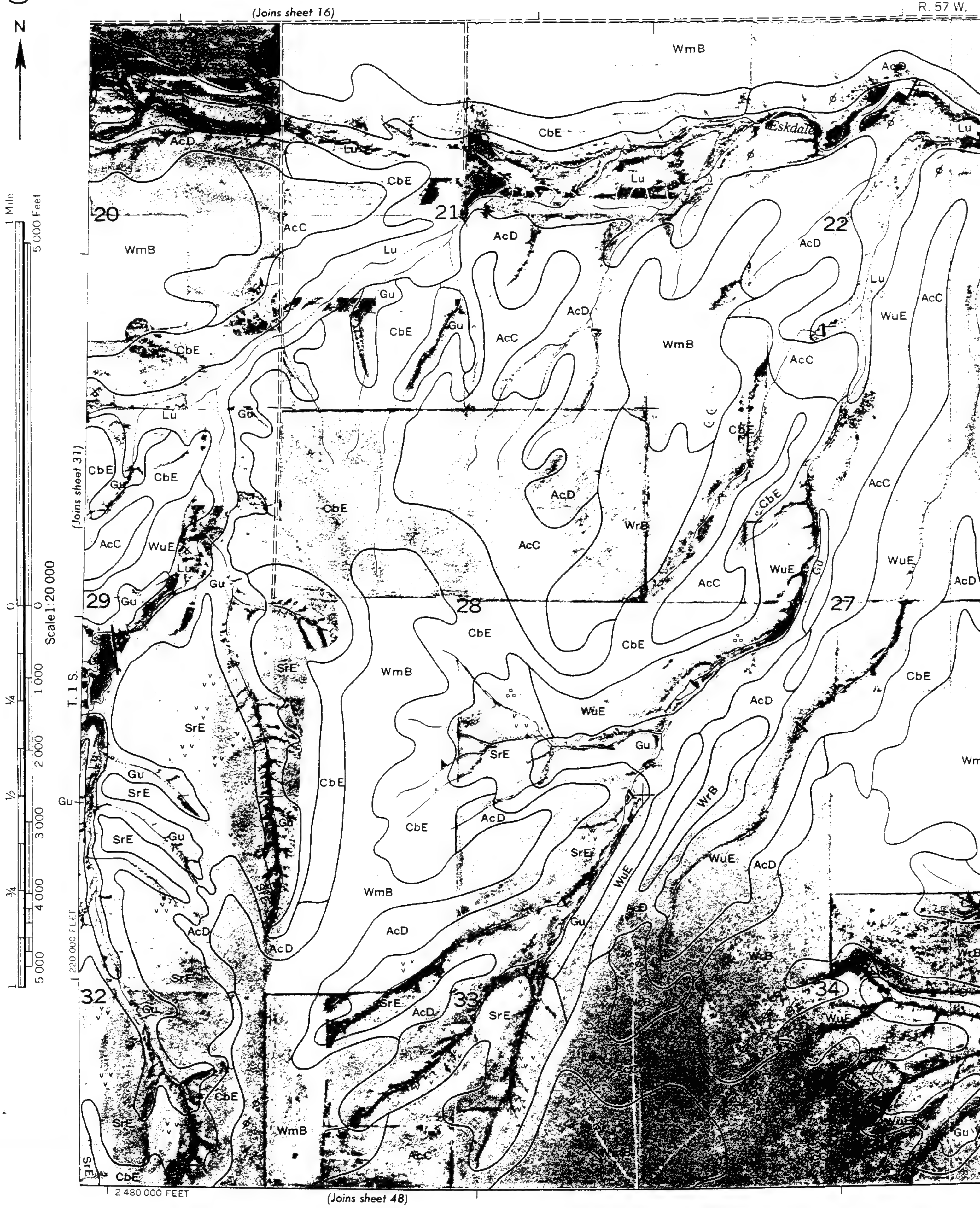

N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 14)
R. 59 W.
R. 58 W.
(Joins sheet 29)
(Joins sheet 46)
220 000 FEET
2 435 000 FEET
23
24
19
26
25
30
35
31
AvC
WuE
CbE
Lu
AcC
AaB
WmB
ArC
Bt
Gu
AcD
AdB
TrE
VsD
AsB

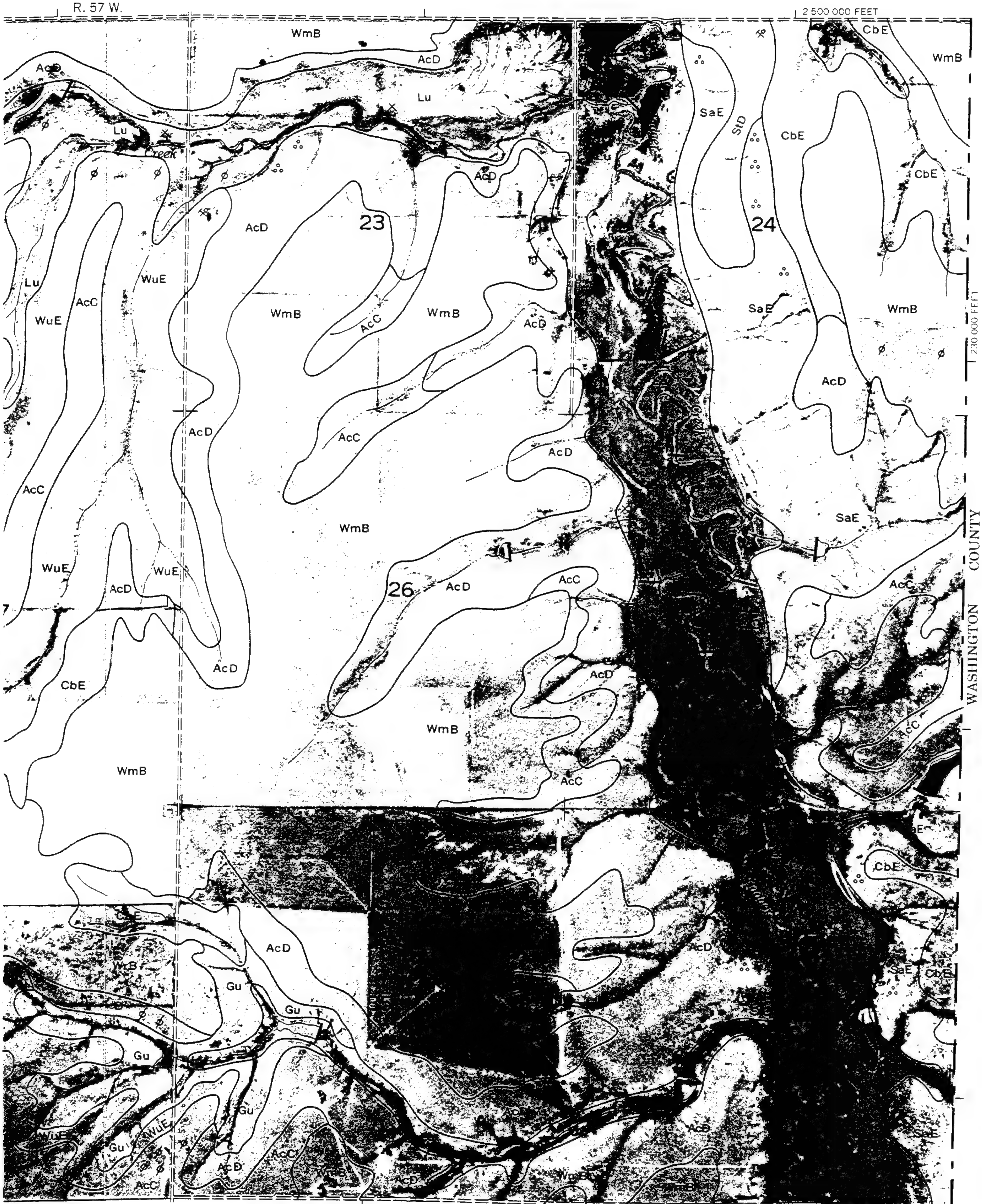
COLORADO — SHEET NUMBER 30



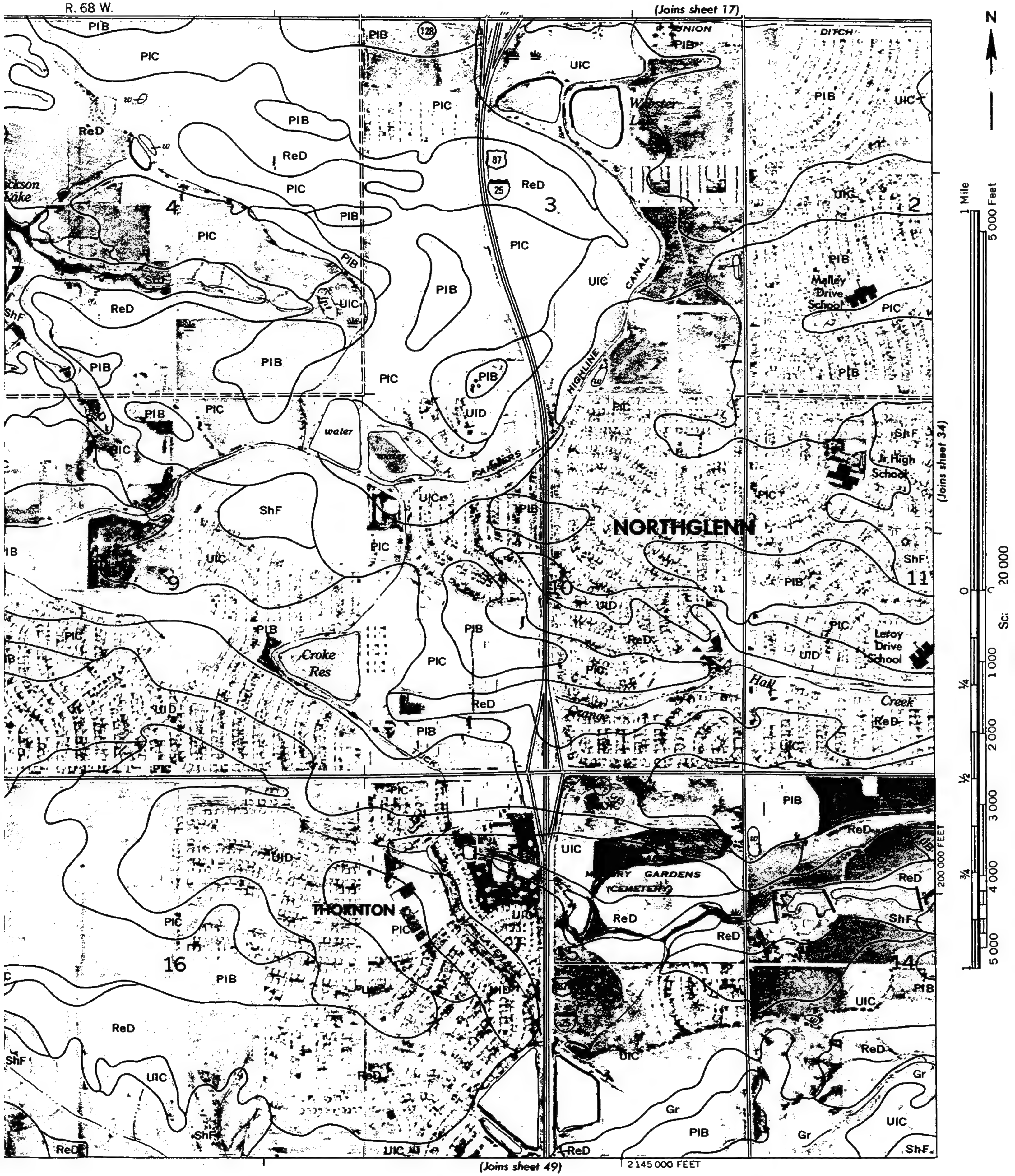

2 460 000 FEET
230 000 FEET
T. 1 S.
(Joins sheet 30)
22
23
24
26
27
34
35
36
WmB
CbE
AcD
AcC
Gu
SrE
AdB
WuE
Lu
AcC
CbE

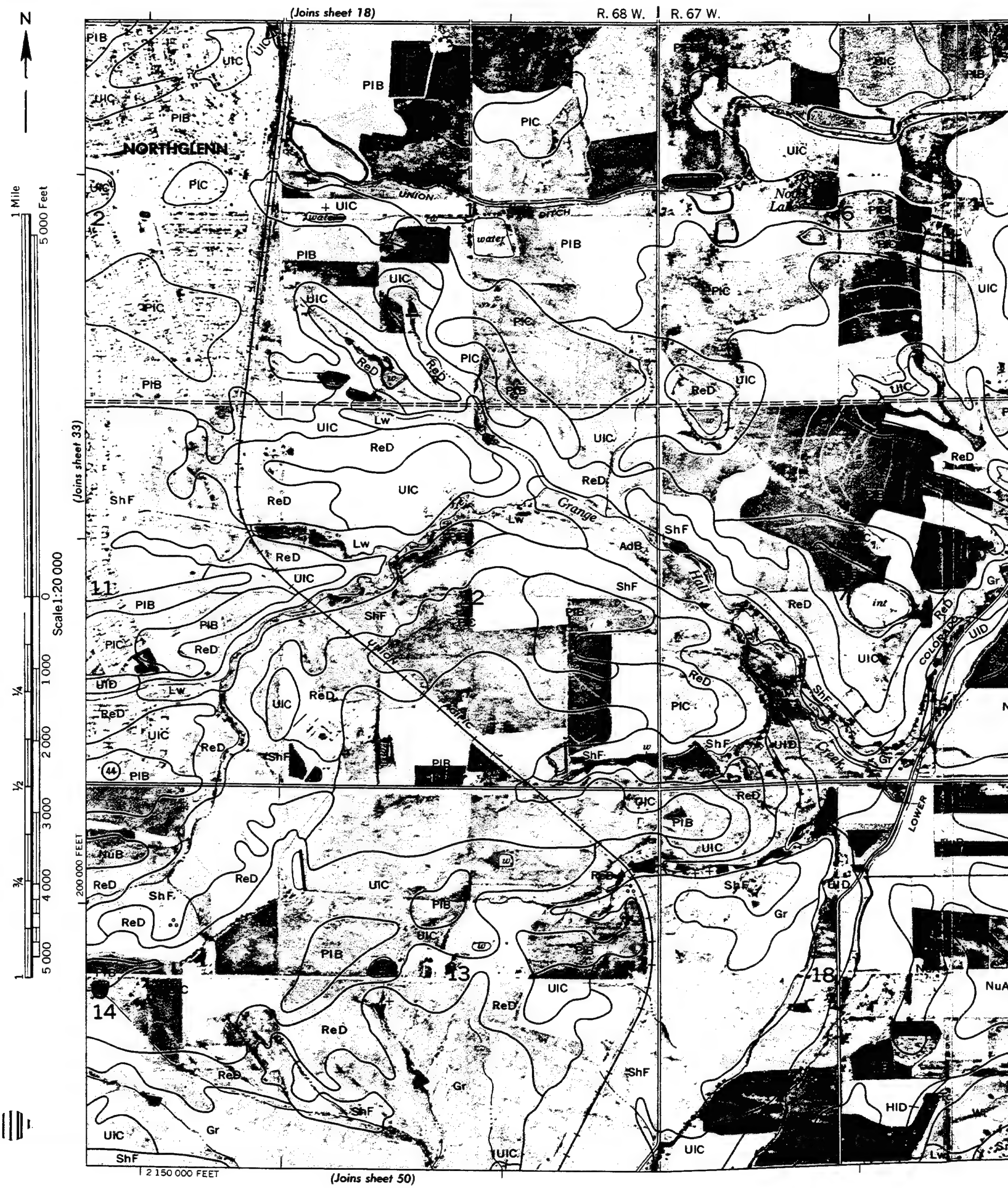

31
N
(Joins sheet 15)
R. 58 W.
R. 57 W.
(Joins sheet 32)
(Joins sheet 47)
2 475 000 FEET
220 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
24
19
20
30
29
36
31
32
AdB
AcC
CbE
WuE
WmB
AcD
Lu
Gu
SrE
San
Creek

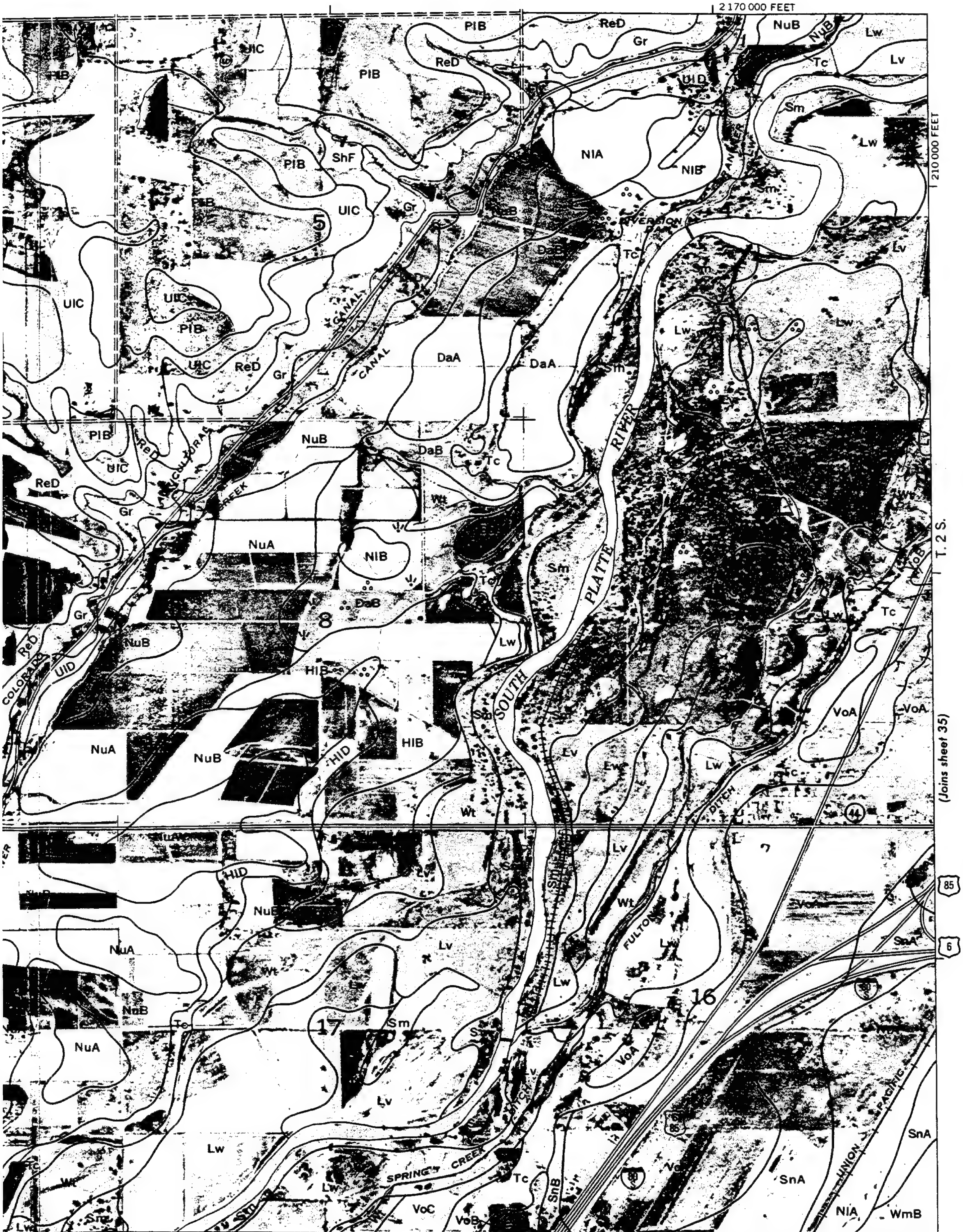

N
(Joins sheet 16)
R. 57 W.
(Joins sheet 31)
(Joins sheet 48)
T. 1 S.
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
220 000 FEET
2 480 000 FEET
Eskdale
20
21
22
27
28
29
32
33
34
WmB
AcD
CbE
Lu
AcC
Gu
WuE
WrB
SrE
AcD
CbE
Lu
AcC
WmB
Gu
SrE
WuE
WrB


R. 57 W.
2 500 000 FEET
230 000 FEET
WASHINGTON COUNTY
23
24
26
Creek
WmB
AcD
Lu
SaE
StD
CbE
AcC
WuE
Gu
WuB

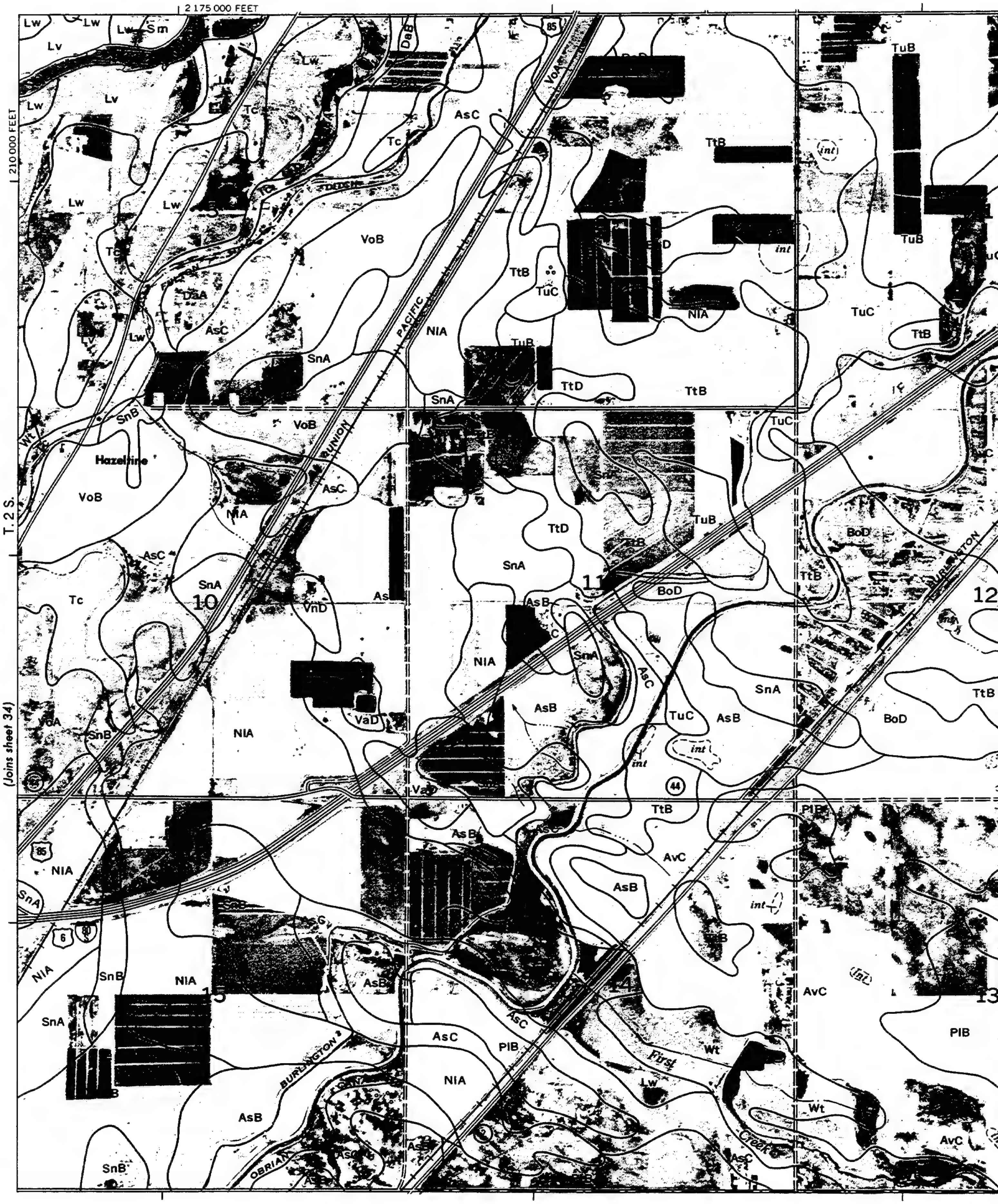

2 130 000 FEET
R. 68 W.
210 000 FEET
T. 2 S.
JEFFERSON COUNTY
287
128
Jackson Lake
Savery Ponds
Big Dry Creek
FARMERS HIGHLINE CANAL
NIVER CANAL
CANAL
4
5
6
7
8
9
17
18
NuB
PIB
PIC
UID
UIC
ReD
AdB
ShF
Wt
w

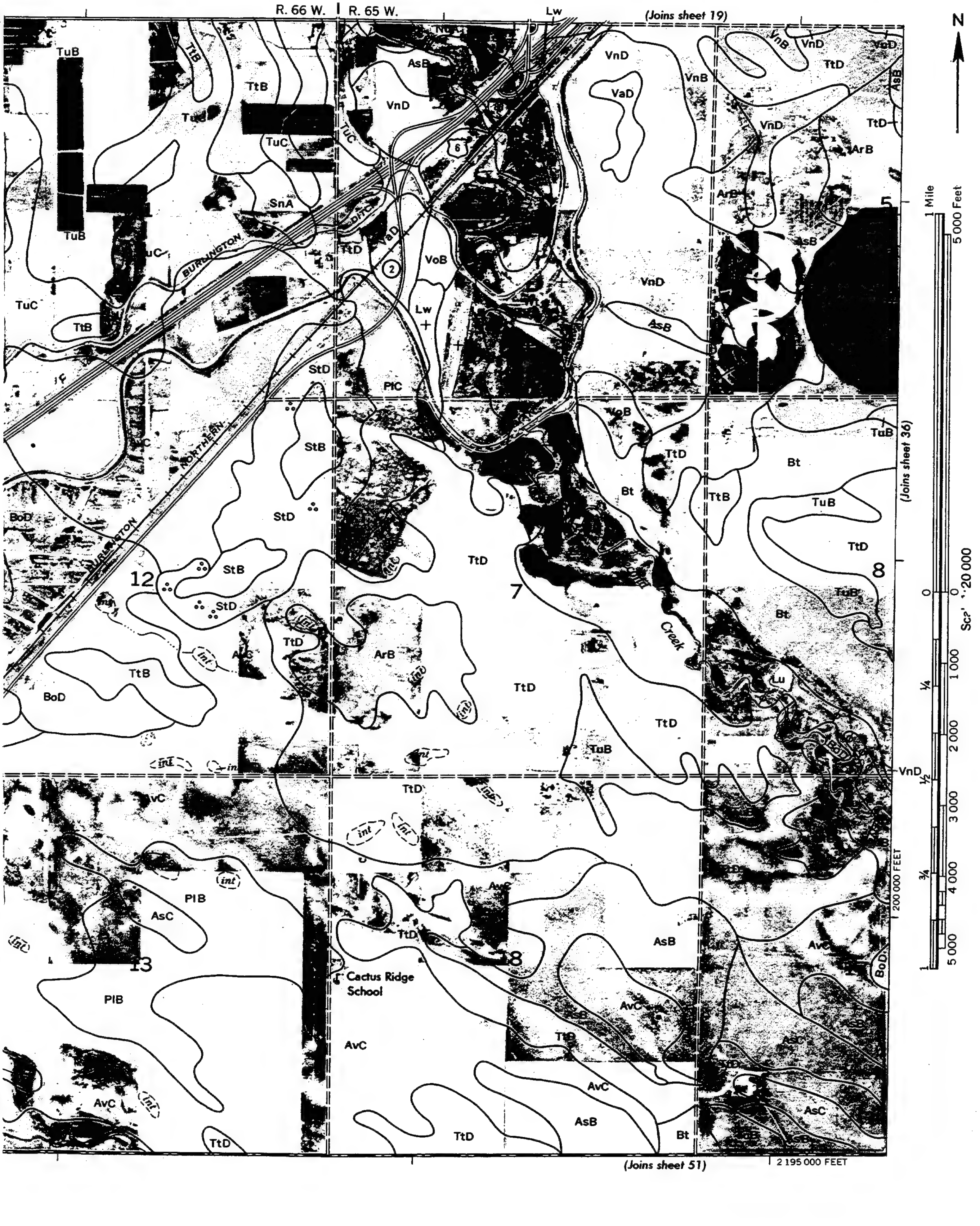

R. 68 W.
(Joins sheet 17)
(Joins sheet 34)
(Joins sheet 49)
N
UNION DITCH
Webster Lake
Malley Drive School
Jr. High School
NORTHGLENN
Leroy Drive School
Hall Creek
Grange
Croke Res
water
HIGHLINE CANAL
FARMERS
THORNTON
GARDENS (CEMETERY)
PIC
PIB
ReD
UIC
UID
ShF
Gr
2 145 000 FEET
200 000 FEET
1 Mile
5 000 Feet
20 000

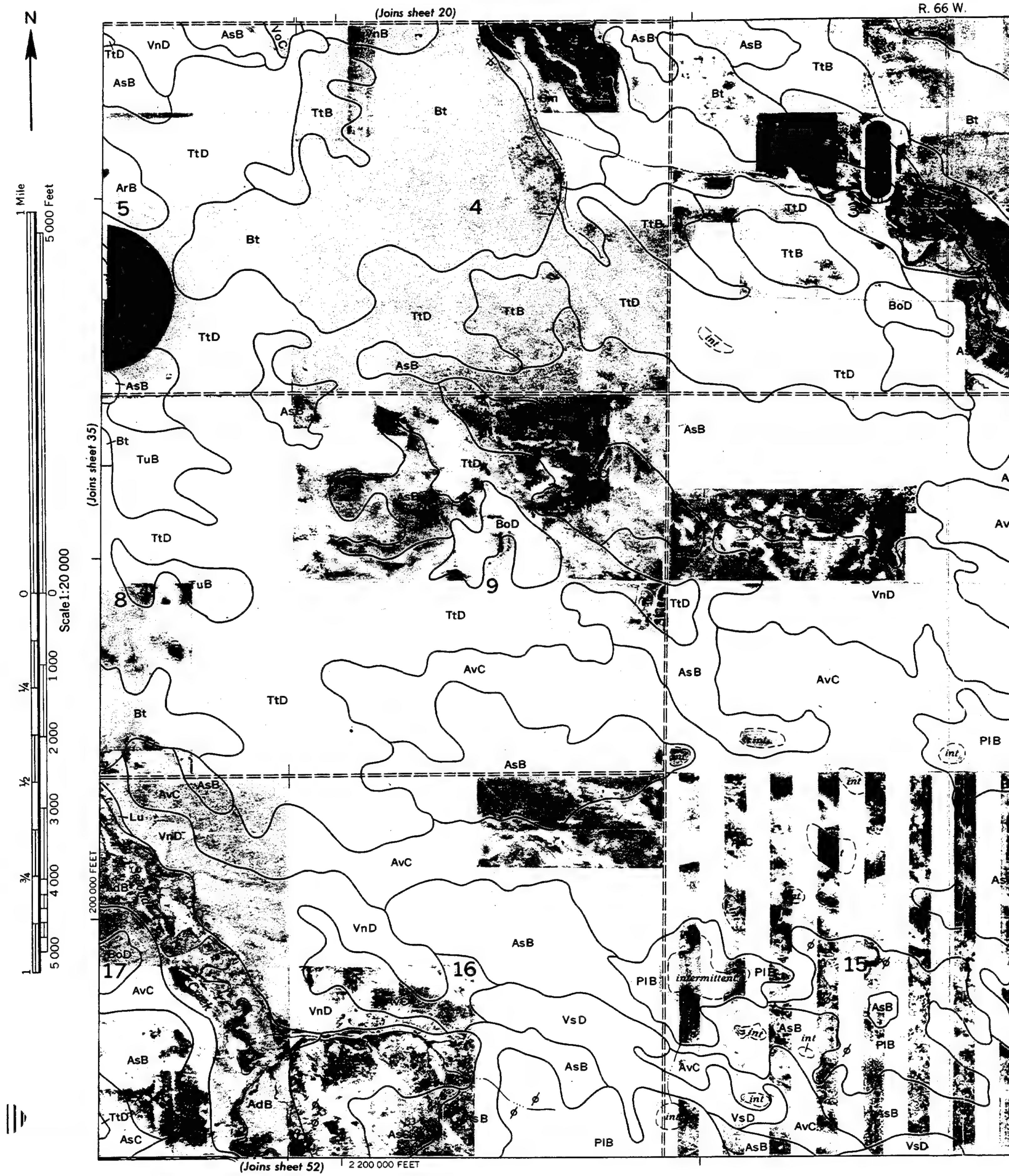

N
1 Mile
5 000 Feet
Scale 1:20 000
0
1 000
2 000
3 000
4 000
5 000
1/4
1/2
3/4
(Joins sheet 18)
R. 68 W.
R. 67 W.
(Joins sheet 33)
(Joins sheet 50)
200 000 FEET
2 150 000 FEET
NORTHGLENN
UNION
DITCH
Grange
Hall
Creek
COLORADO
LOWER
UNION PACIFIC
water
int
2
11
12
13
14
18
44
PIB
PIC
UIC
UID
ReD
Lw
ShF
AdB
Gr
NuB
HID
NuA

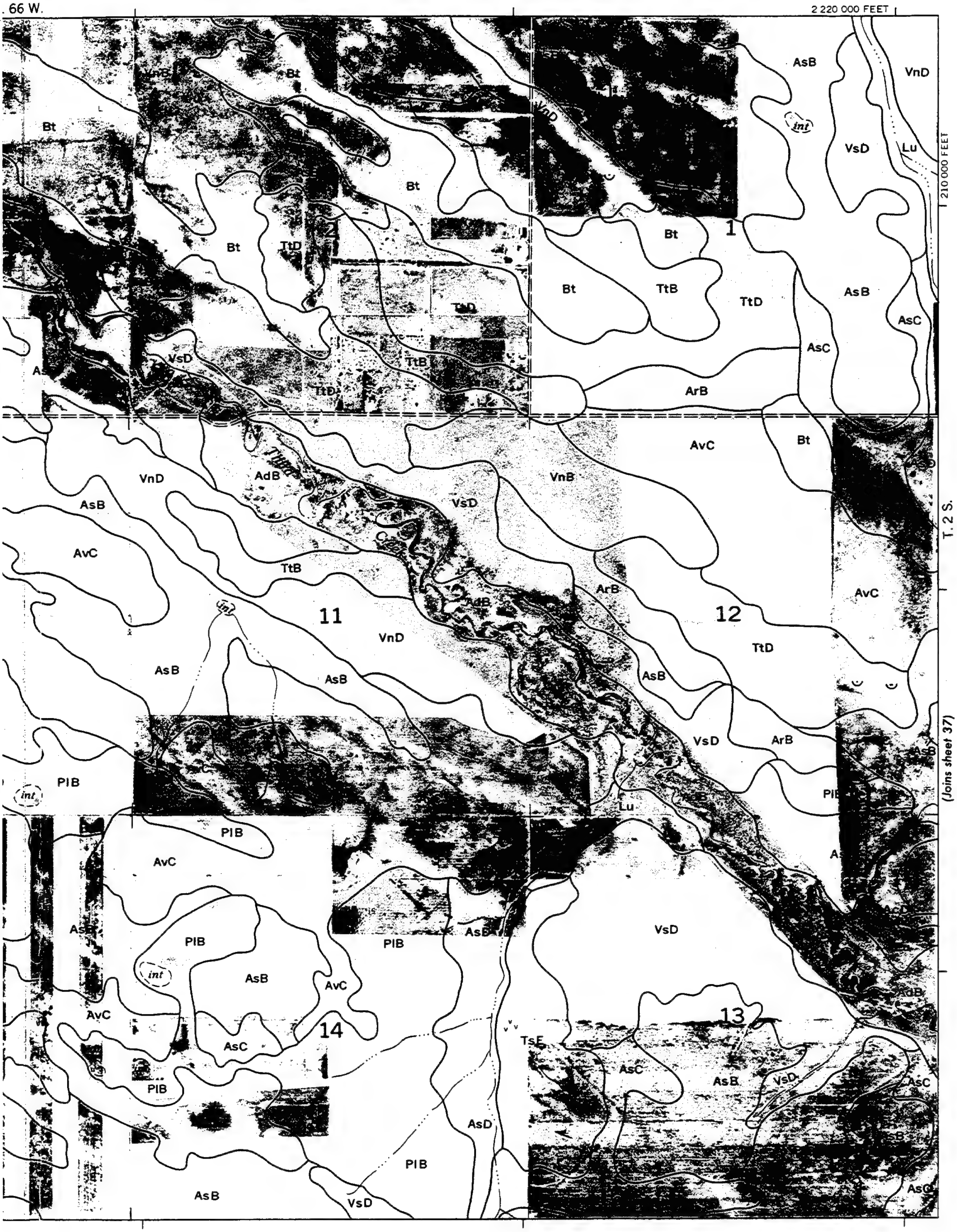


Land division corners are approximately positioned on this map.

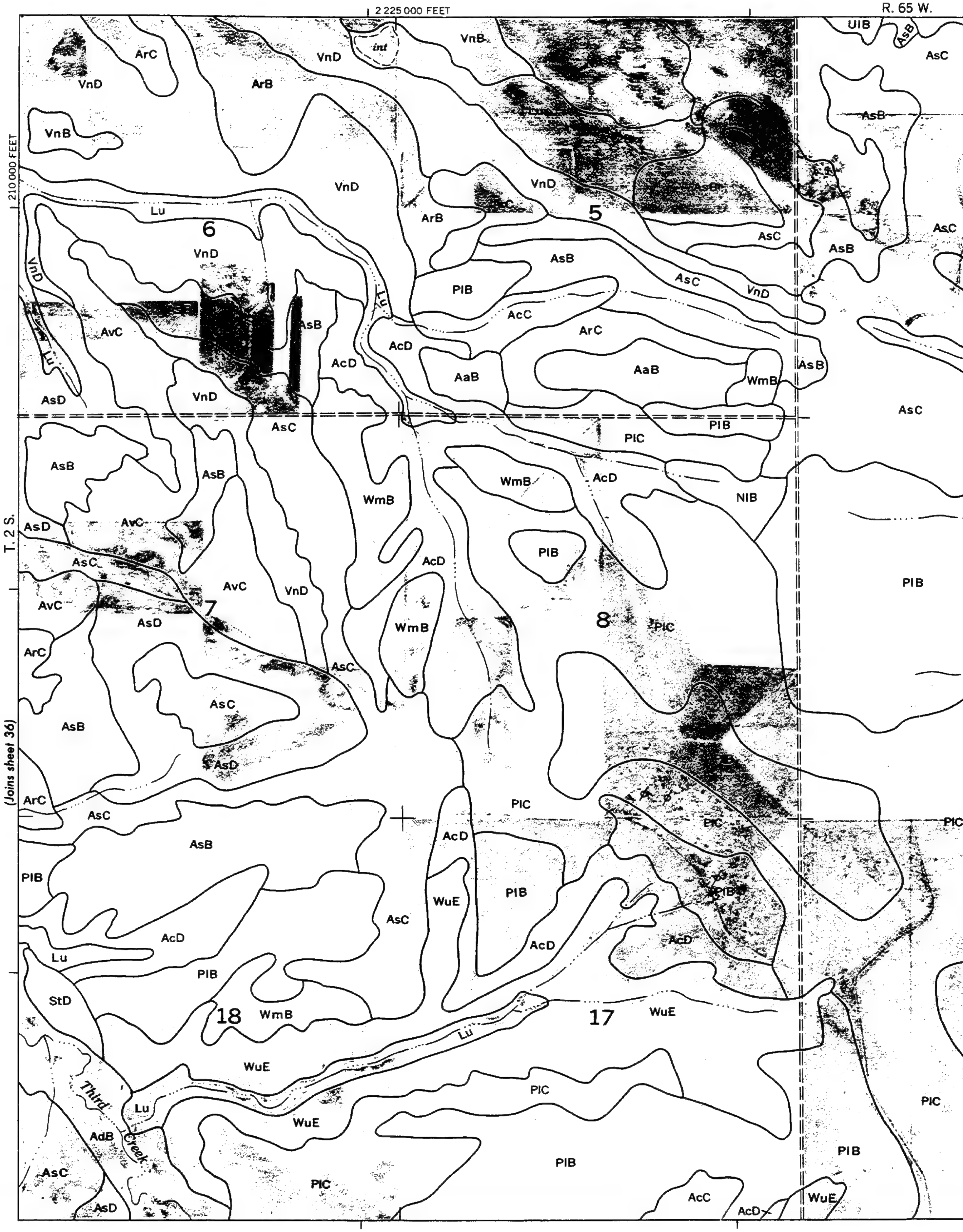

2 175 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 34)
Hazeltine
PACIFIC
UNION
BURLINGTON
First
Creek
OBRIAN
10
11
12
13
14
15
Lw
Lv
Sm
Tc
AsC
VoB
VoA
DaA
DaB
TtB
TtD
TuB
TuC
BoD
NIA
SnA
SnB
AsB
VaD
VnD
int
PIB
AvC
Wt
AsG
85
44
6
80

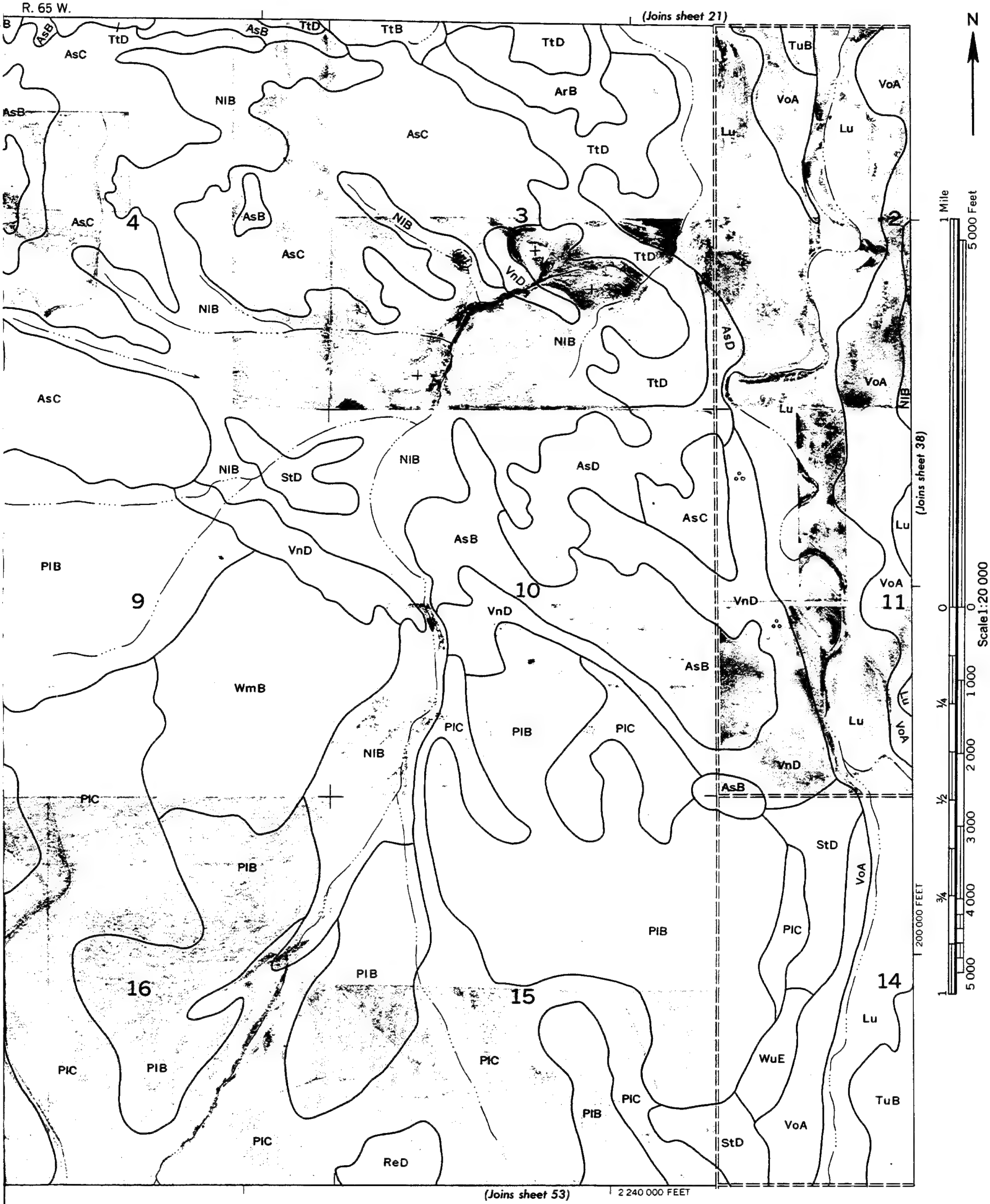

R. 66 W.
R. 65 W.
(Joins sheet 19)
(Joins sheet 36)
(Joins sheet 51)
N
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
200 000 FEET
2 195 000 FEET
BURLINGTON
NORTHERN
BURLINGTON
6
2
Creek
Cactus Ridge
School
5
7
8
12
13
18
TuB
TtB
TuC
TtD
SnA
AsB
VnD
VnB
VaD
VoB
Lw
PlC
StD
StB
BoD
ArB
TtD
Bt
Lu
int
AvC
AsC
PlB

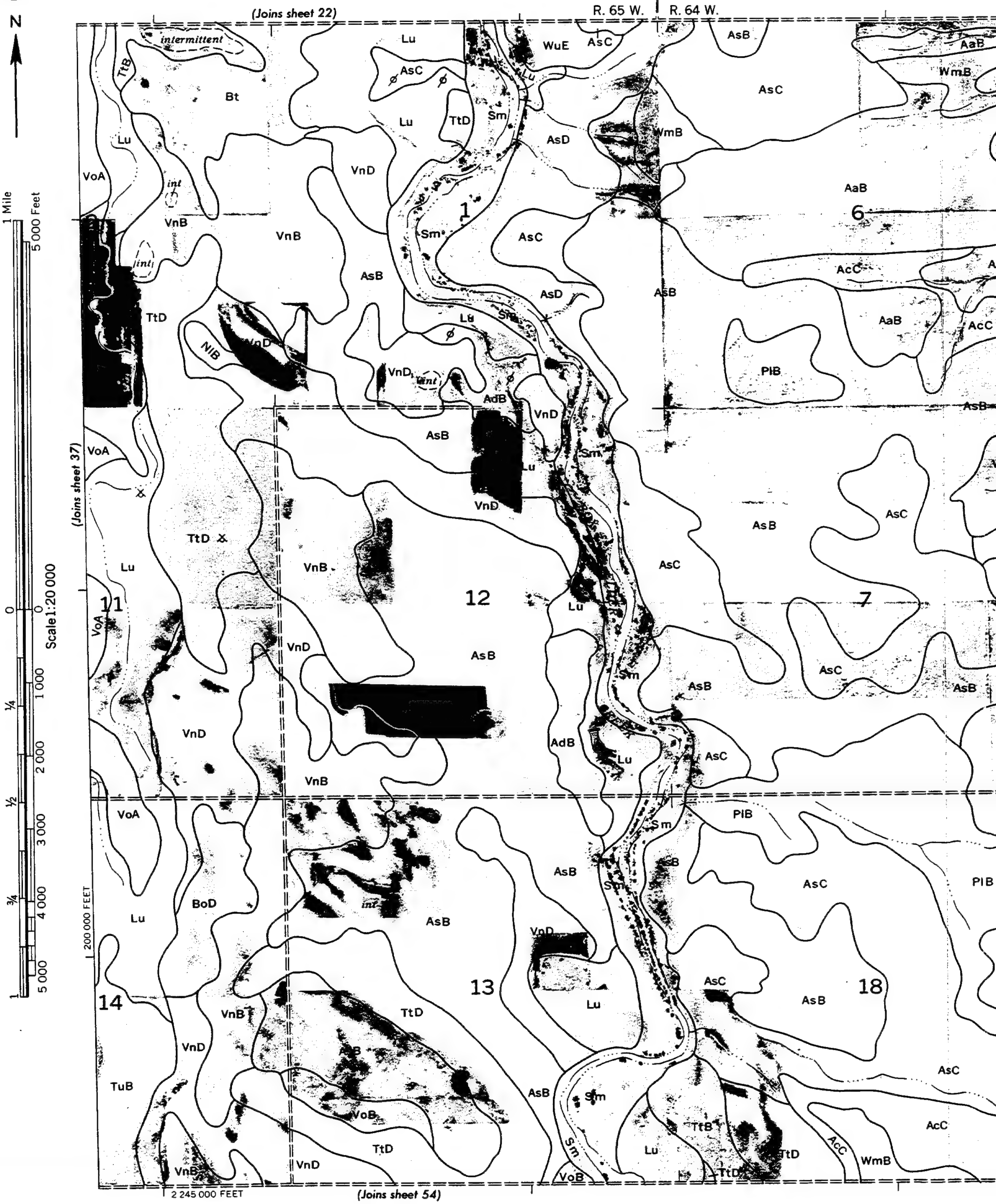

N
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1000
¼
2 000
½
3 000
¾
4 000
5 000
1
(Joins sheet 20)
(Joins sheet 35)
(Joins sheet 52)
R. 66 W.
200 000 FEET
2 200 000 FEET
5
4
3
8
9
17
16
15
VnD
AsB
TtD
ArB
Bt
TtB
TuB
BoD
AvC
PlB
VsD
AdB
AsC
Lu
intermittent
int

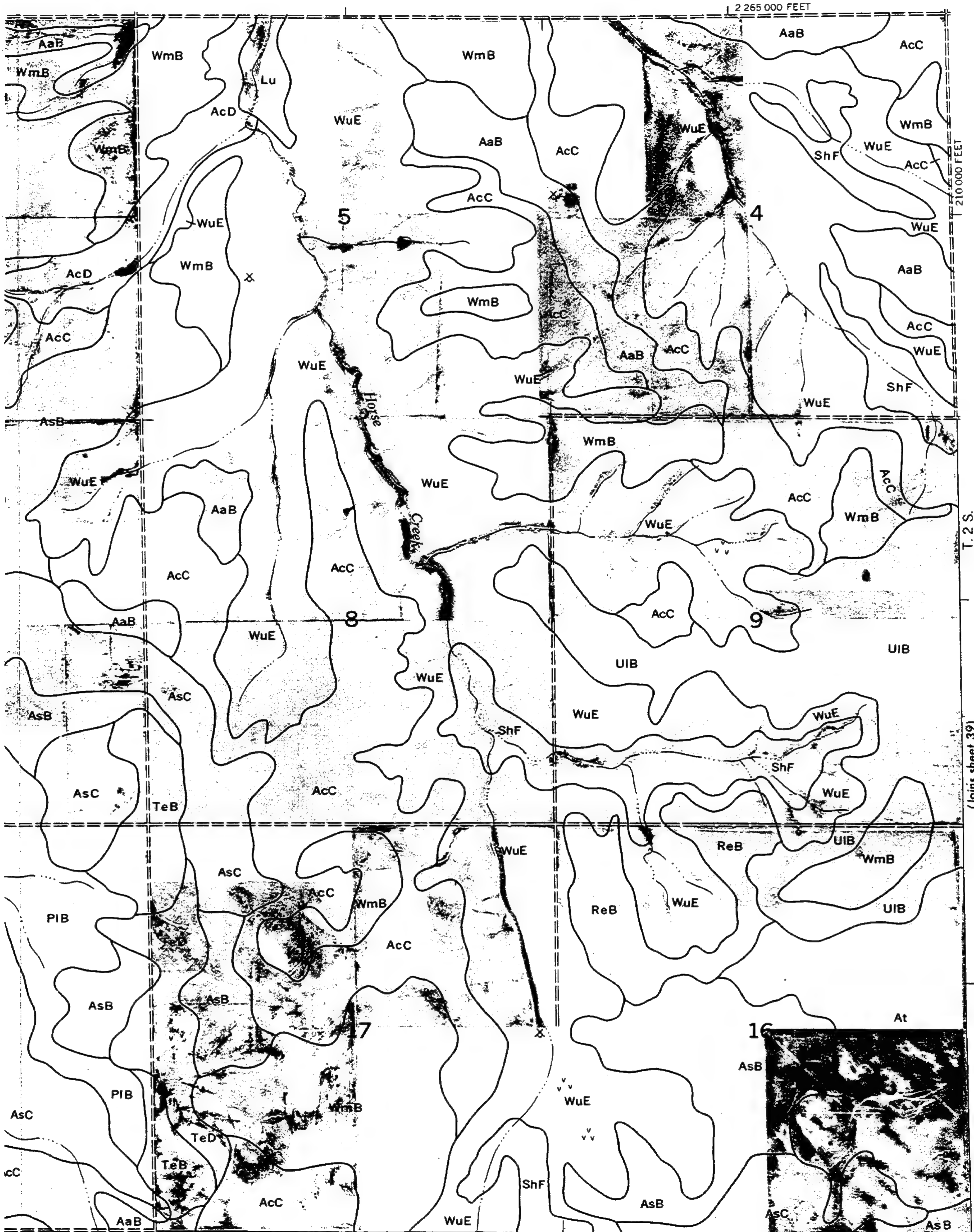


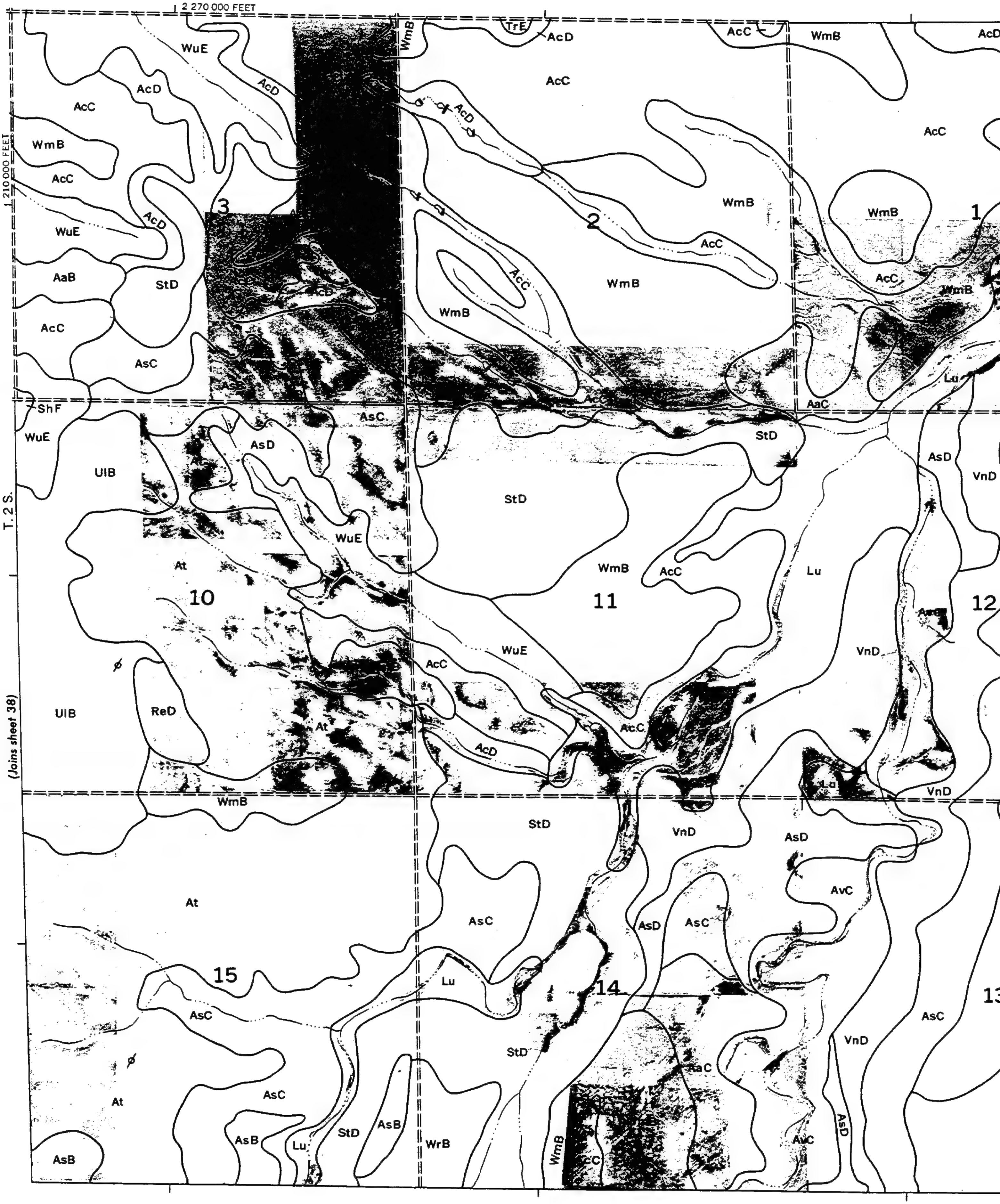
Land division corners are approximately positioned on this map

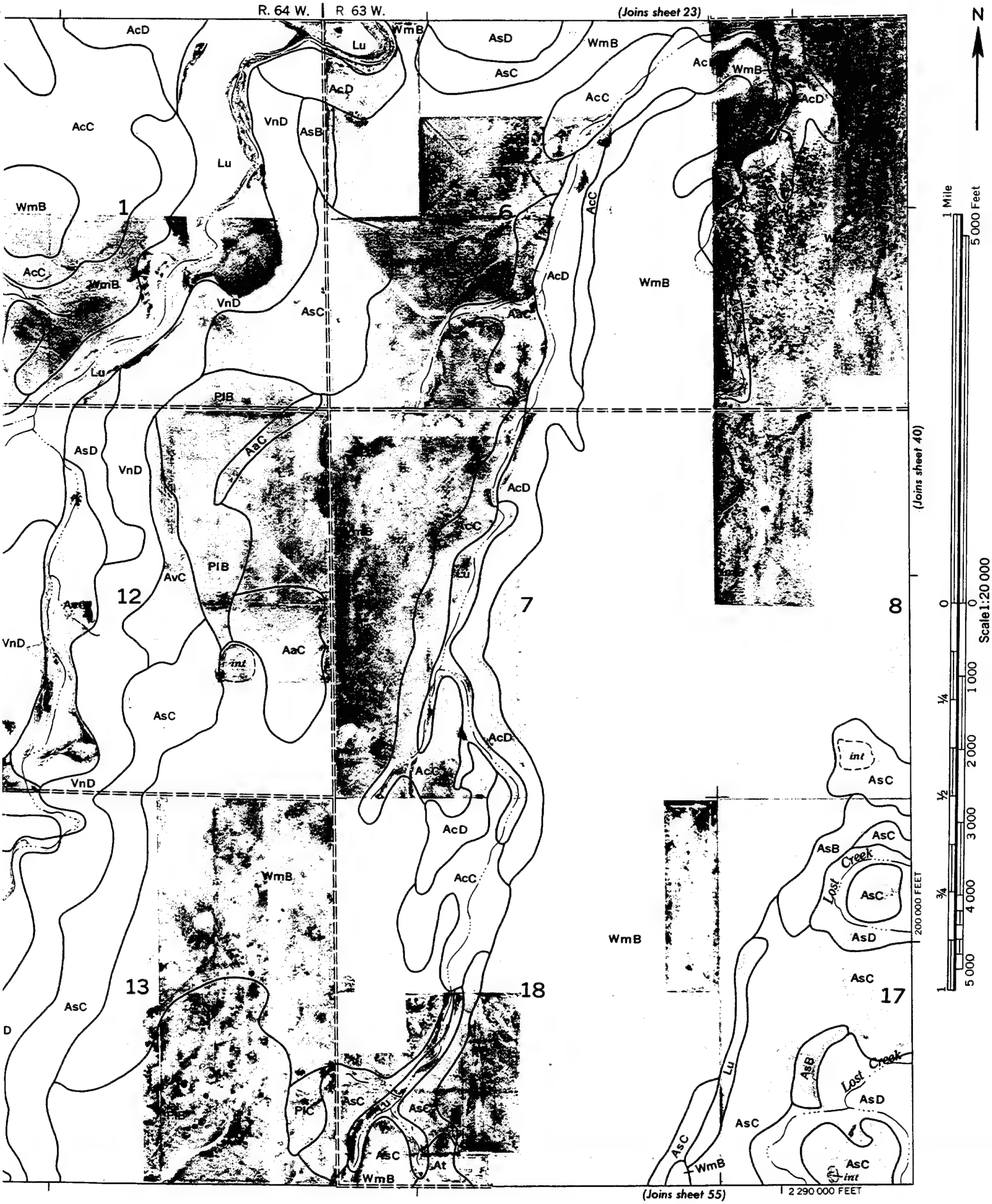

2 225 000 FEET
R. 65 W.
210 000 FEET
T. 2 S.
(Joins sheet 36)
5
6
7
8
17
18
Third Creek
int
ArC
VnD
VnB
ArB
VnD
VnB
UIB
AsB
AsC
Lu
ArB
AsC
AsB
PIB
AcC
ArC
AaB
WmB
AcD
AvC
AsD
AsC
WmB
PIC
NIB
PIB
AsB
AvC
AsD
AsC
ArC
AsB
PIC
WuE
StD
AdB
AcC

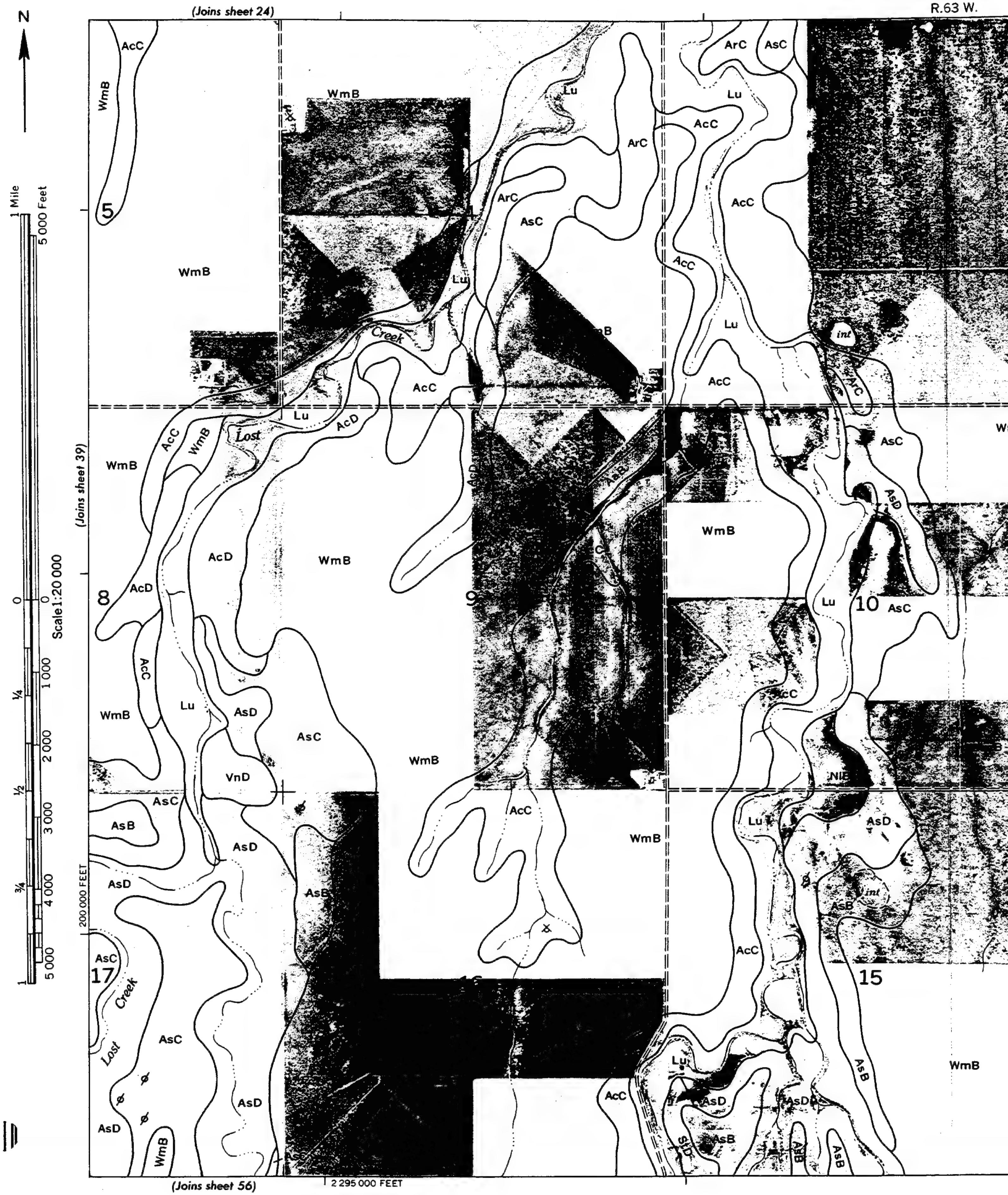

R. 65 W.
(Joins sheet 21)
(Joins sheet 38)
(Joins sheet 53)
2 240 000 FEET
200 000 FEET
N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
2
3
4
9
10
11
14
15
16
AsB
AsC
AsD
ArB
TtB
TtD
TuB
NlB
VnD
VoA
Lu
StD
PlB
PlC
WmB
WuE
ReD

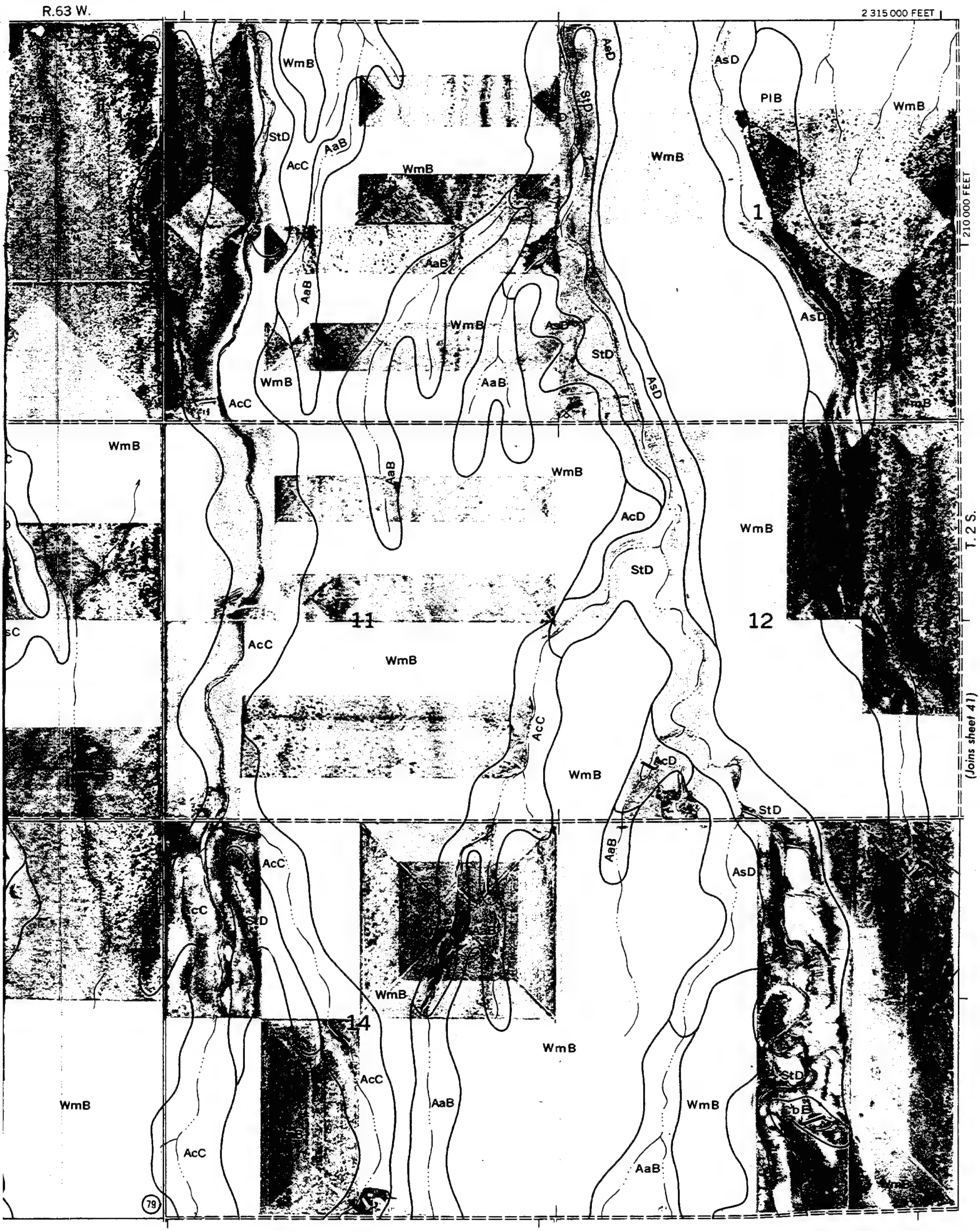

N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 22)
R. 65 W.
R. 64 W.
(Joins sheet 37)
(Joins sheet 54)
200 000 FEET
2 245 000 FEET
intermittent
int
1
6
7
11
12
13
14
18
TtB
Bt
Lu
AsC
TtD
Sm
WuE
AsB
AaB
WmB
AsD
VoA
VnB
VnD
NlB
AcC
PlB
AdB
BoD
TuB
VoB
AsC


2 265 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 39)
Horse Creek
5
4
8
9
17
16
AaB
WmB
Lu
AcD
WuE
AcC
ShF
AsB
AsC
TeB
TeD
PlB
UlB
ReB
At


2 270 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 38)
WuE
AcD
AcC
WmB
AcC
WuE
AaB
StD
AcC
AsC
3
WmB
TrE
AcD
AcC
AcD
2
WmB
AcC
AcC
WmB
WmB
WmB
AcC
AcD
1
WmB
AcC
WmB
Lu
AaC
ShF
WuE
UIB
AsD
AsC
At
WuE
10
UIB
ReD
At
StD
StD
WmB
AcC
11
WuE
AcC
AcD
AcC
Lu
AsD
VnD
12
VnD
VnD
Lu
WmB
At
15
AsC
At
AsC
AsB
AsB
StD
VnD
AsD
AvC
AsC
AsD
AsC
Lu
14
StD
StD
AsB
Lu
WrB
WmB
AaC
VnD
AsD
AvC
AsC
13

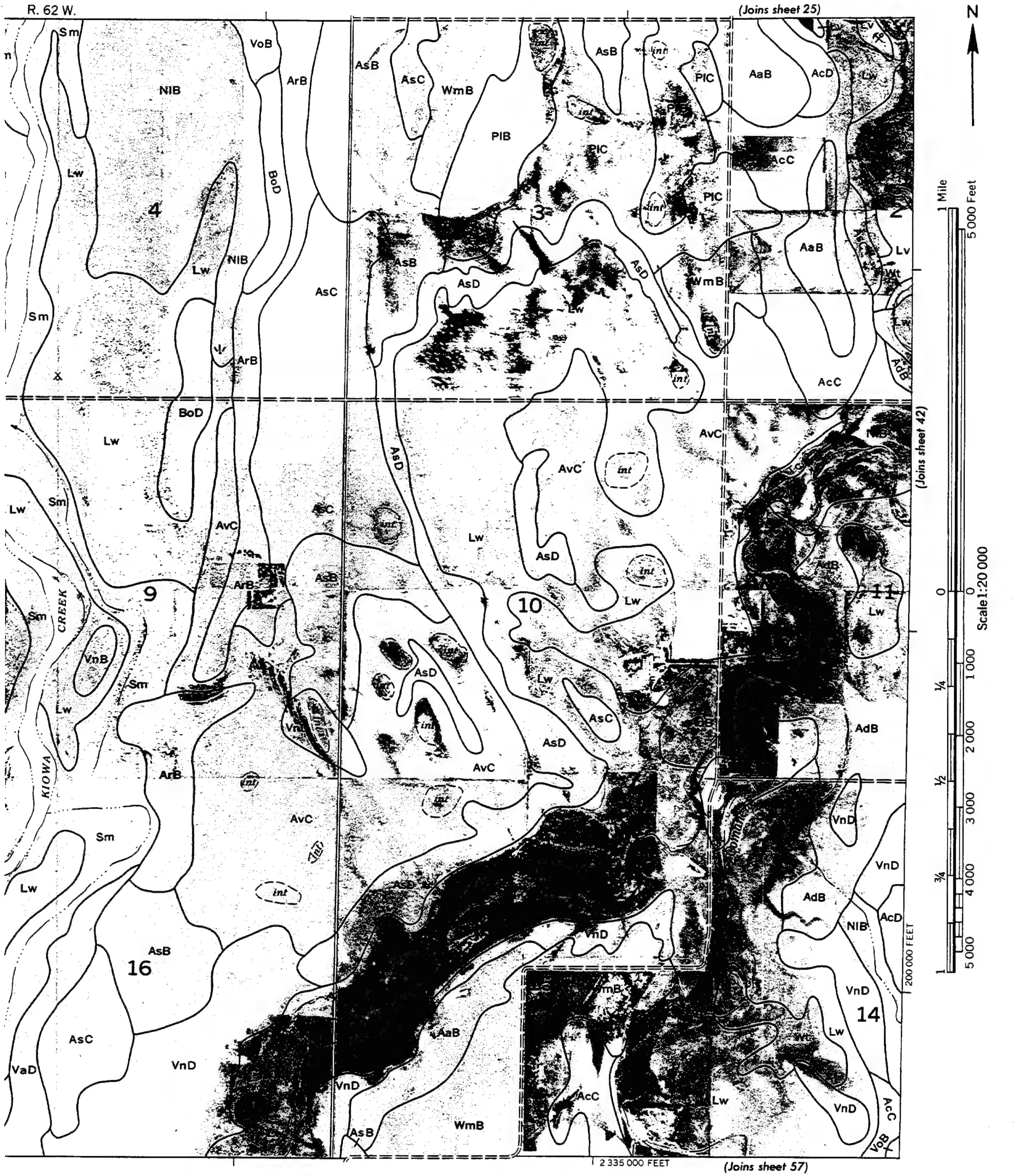

R. 64 W.
R. 63 W.
(Joins sheet 23)
(Joins sheet 40)
(Joins sheet 55)
N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
200 000 FEET
2 290 000 FEET
1
6
7
8
12
13
17
18
AcD
AcC
AsD
AsC
AsB
WmB
Lu
VnD
PlB
AaC
AvC
PlC
At
int
Lost Creek

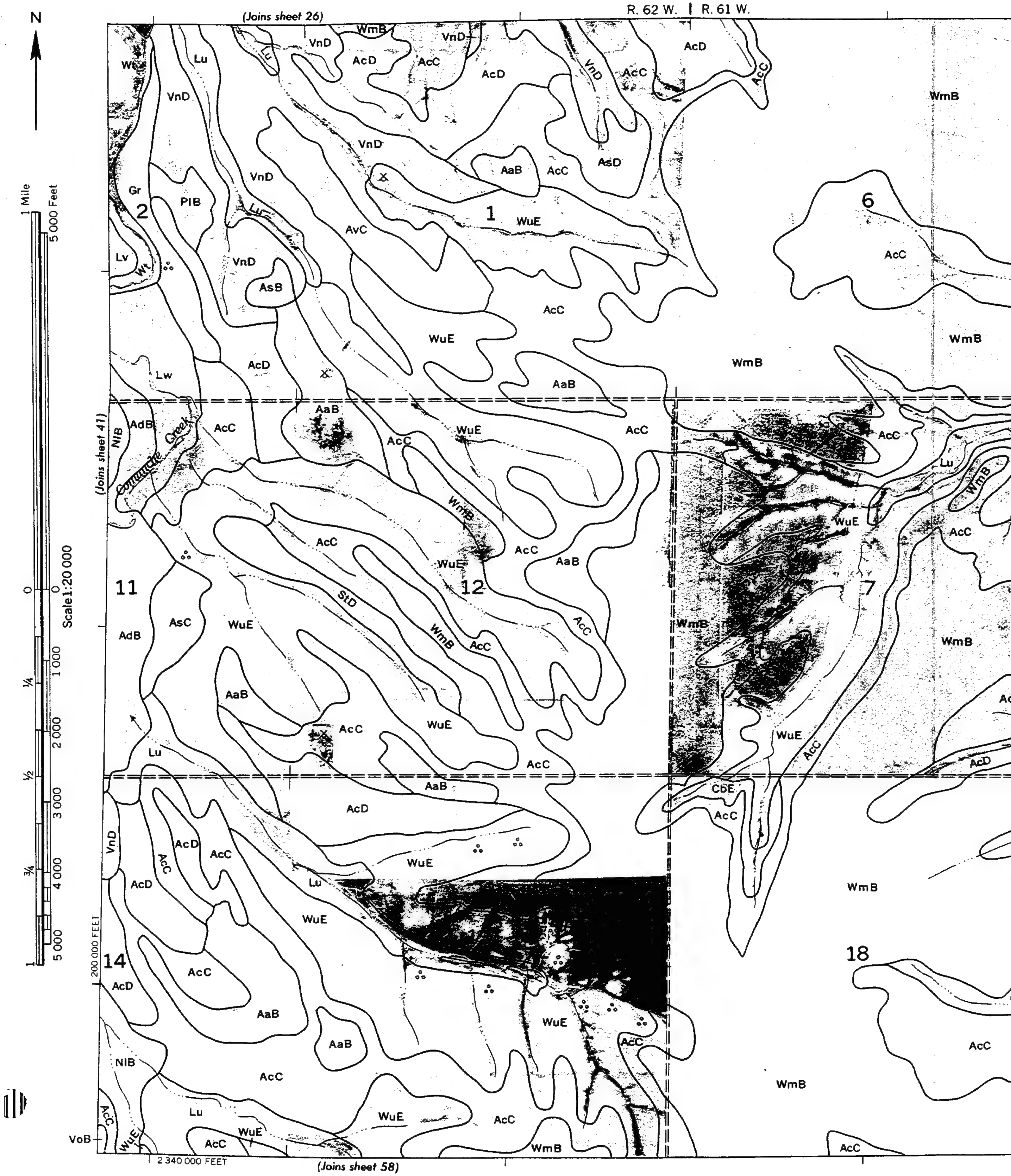

N
(Joins sheet 24)
R.63 W.
(Joins sheet 39)
(Joins sheet 56)
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1 000
¼
2 000
½
3 000
¾
4 000
5 000
1
200 000 FEET
2 295 000 FEET
Lost Creek
5
8
9
10
15
17
WmB
AcC
ArC
AsC
Lu
AcD
AsD
AsB
VnD
int

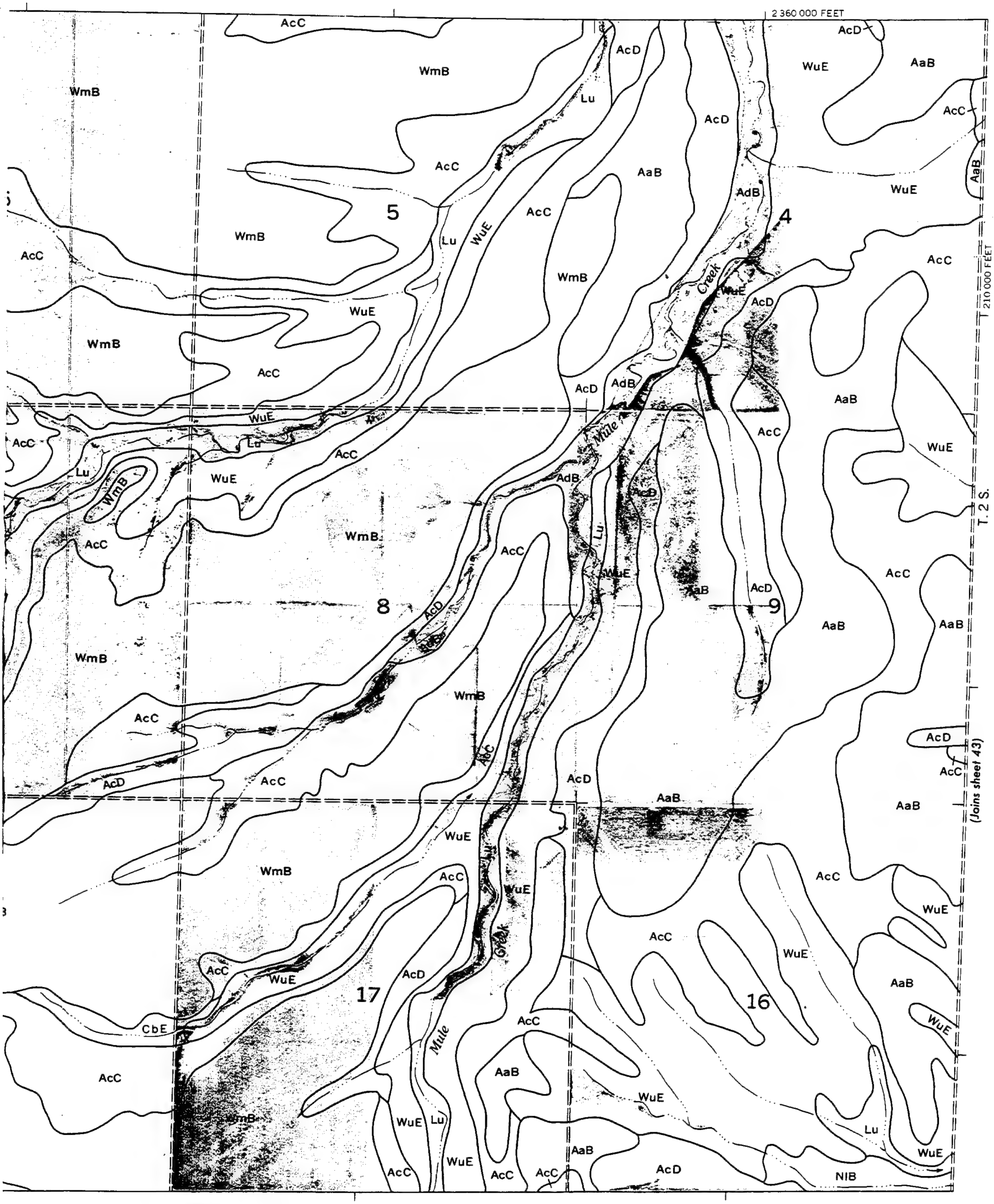


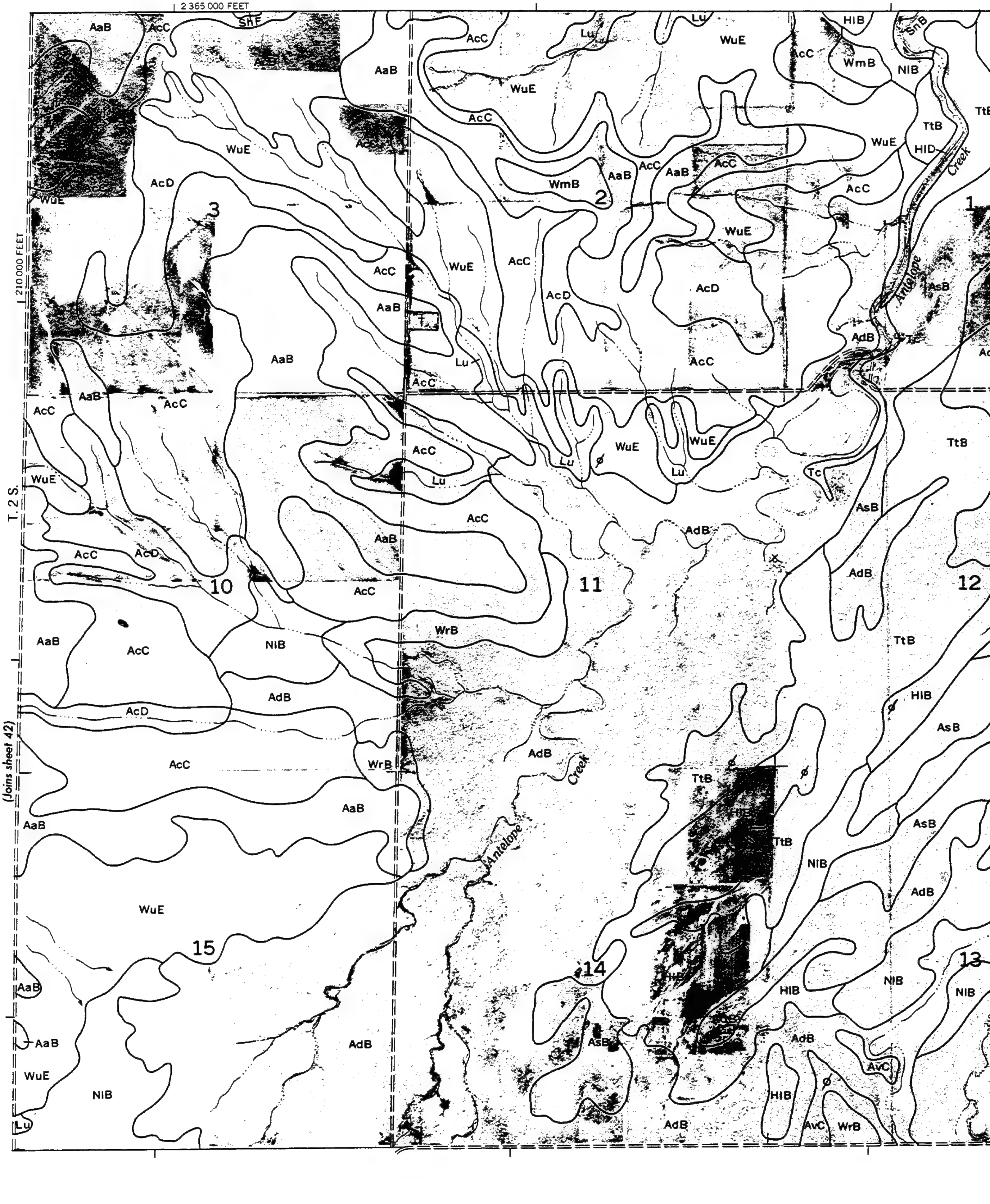
R.63 W.
2 315 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 41)
1
11
12
14
79
WmB
AsD
PlB
AaD
StD
AaB
AcC
AcD
AsD


2 320 000 FEET
R. 62 W.
210 000 FEET
T. 2 S.
(Joins sheet 40)
WmB
StD
AcC
AaC
StD
AaB
Lw
Sm
NIB
VnB
AsB
AsC
VaD
CbE
KIOWA
CREEK
Creek
int
4
5
6
7
8
9
16
17
18

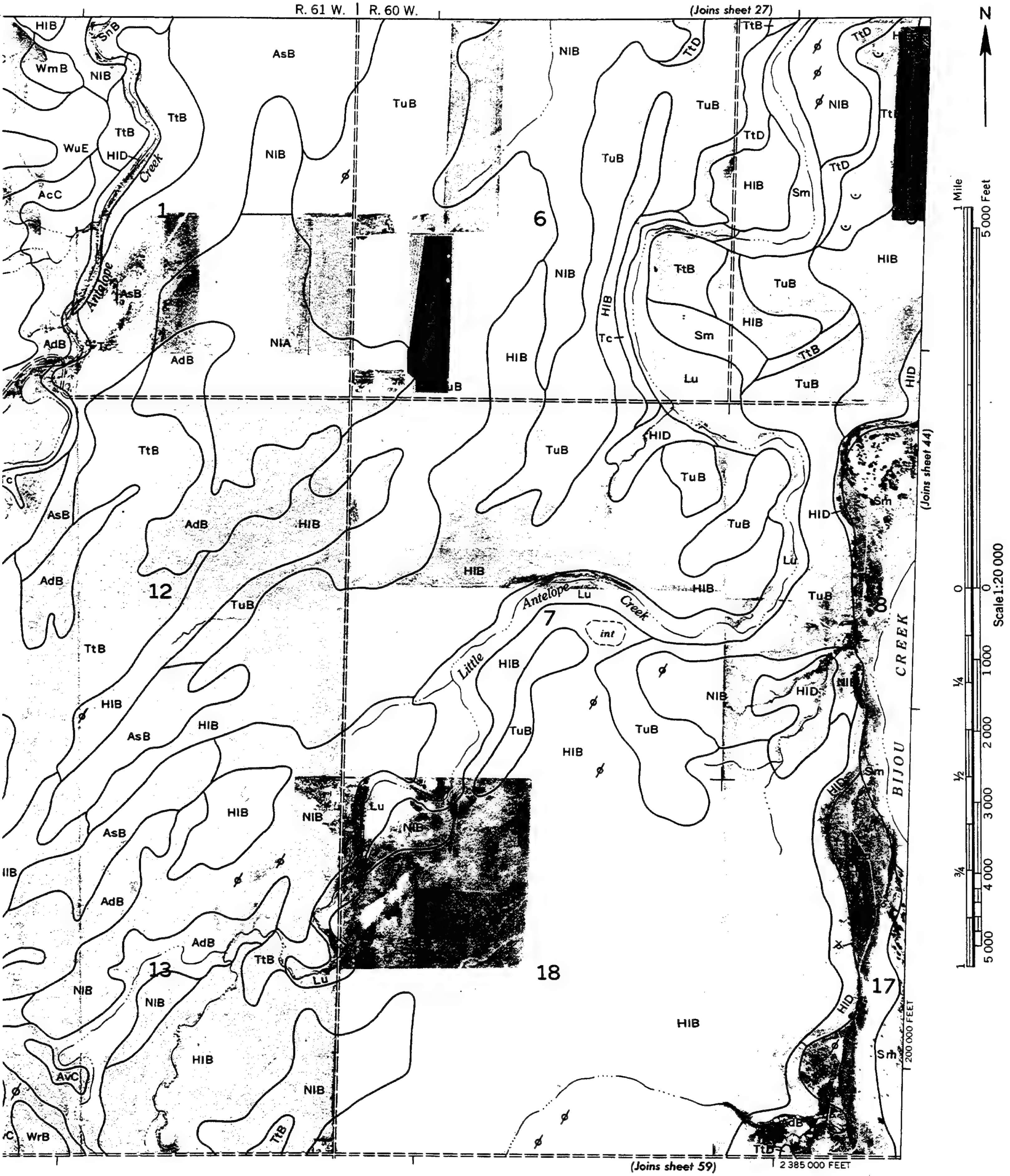

R. 62 W.
(Joins sheet 25)
(Joins sheet 42)
(Joins sheet 57)
N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
200 000 FEET
2 335 000 FEET
KIOWA
CREEK
4
3
2
9
10
11
16
14
Sm
VoB
NlB
ArB
AsB
AsC
WmB
PlB
PlC
AaB
AcD
Lv
Lw
AcC
BoD
AsD
Wt
AdB
AvC
int
VnB
VnD
AcD
VaD
AaB
AcC
WmB
Lw
VoB

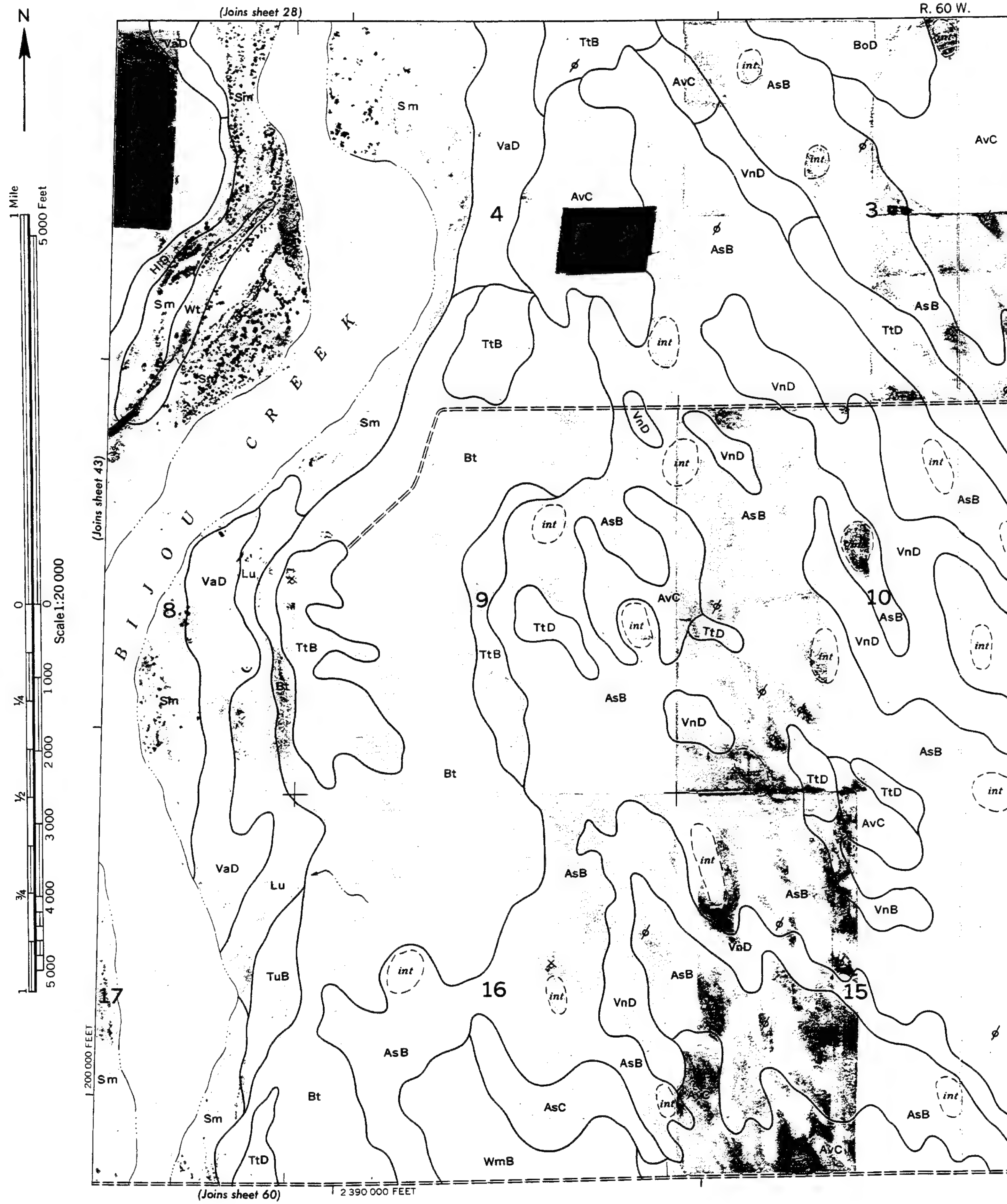

N
(Joins sheet 26)
R. 62 W. | R. 61 W.
(Joins sheet 41)
(Joins sheet 58)
1 Mile
5 000 Feet
Scale 1:20 000
200 000 FEET
2 340 000 FEET
Comanche Creek
1
2
6
7
11
12
14
18
WmB
VnD
AcD
AcC
WuE
AaB
AsD
Lu
Wt
Gr
PlB
Lv
AvC
AsB
Lw
AdB
NlB
AsC
StD
CbE
VoB

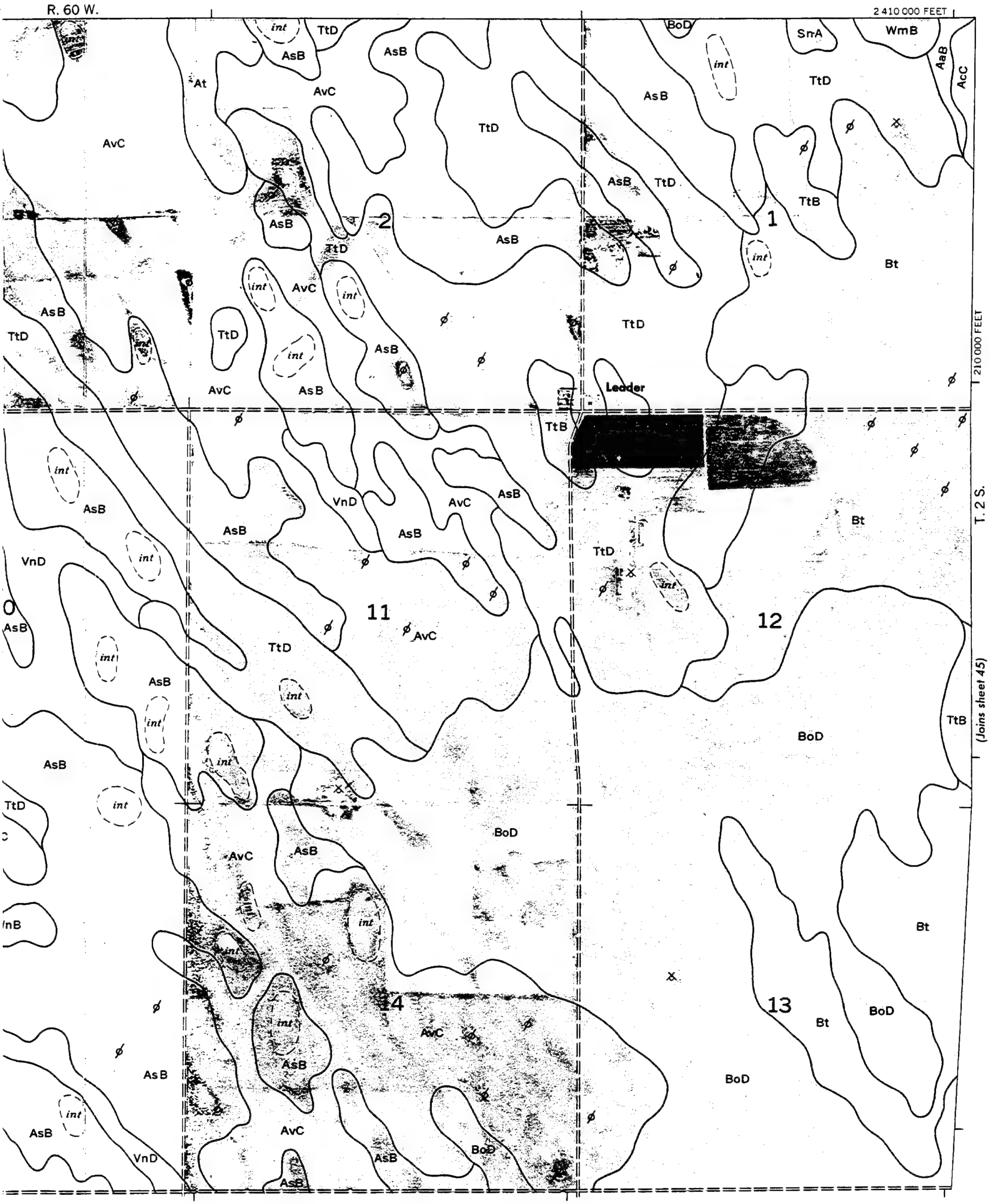

2 360 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 43)
Mule Creek
5
4
8
9
17
16
AcC
AcD
AaB
AdB
WmB
WuE
Lu
CbE
NIB



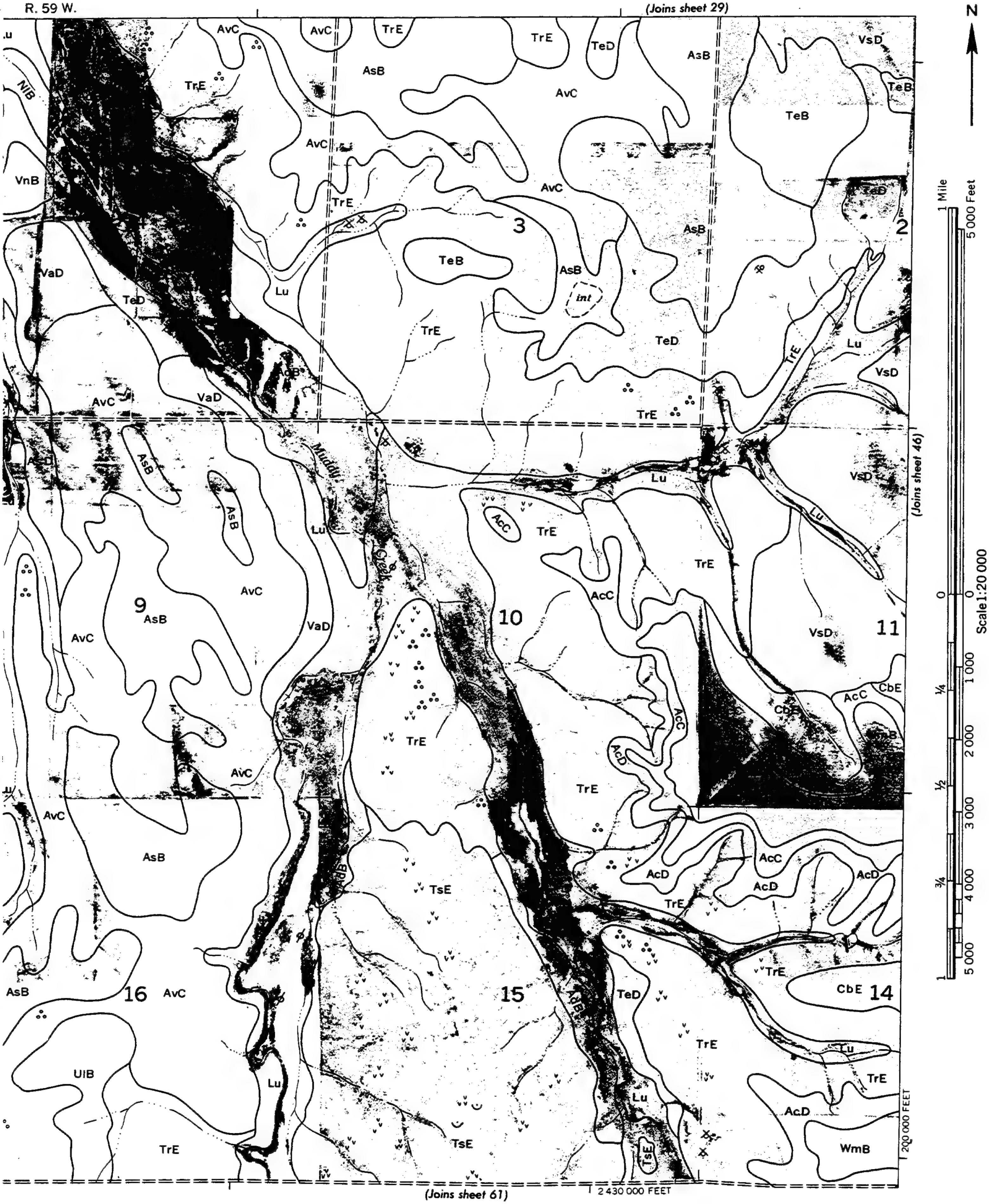
2 365 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 42)
AaB
AcC
SnF
AcD
WuE
WmB
Lu
HlB
SnB
NlB
TtB
HlD
Creek
Antelope
AsB
AdB
Tc
WrB
AvC
1
2
3
10
11
12
13
14
15

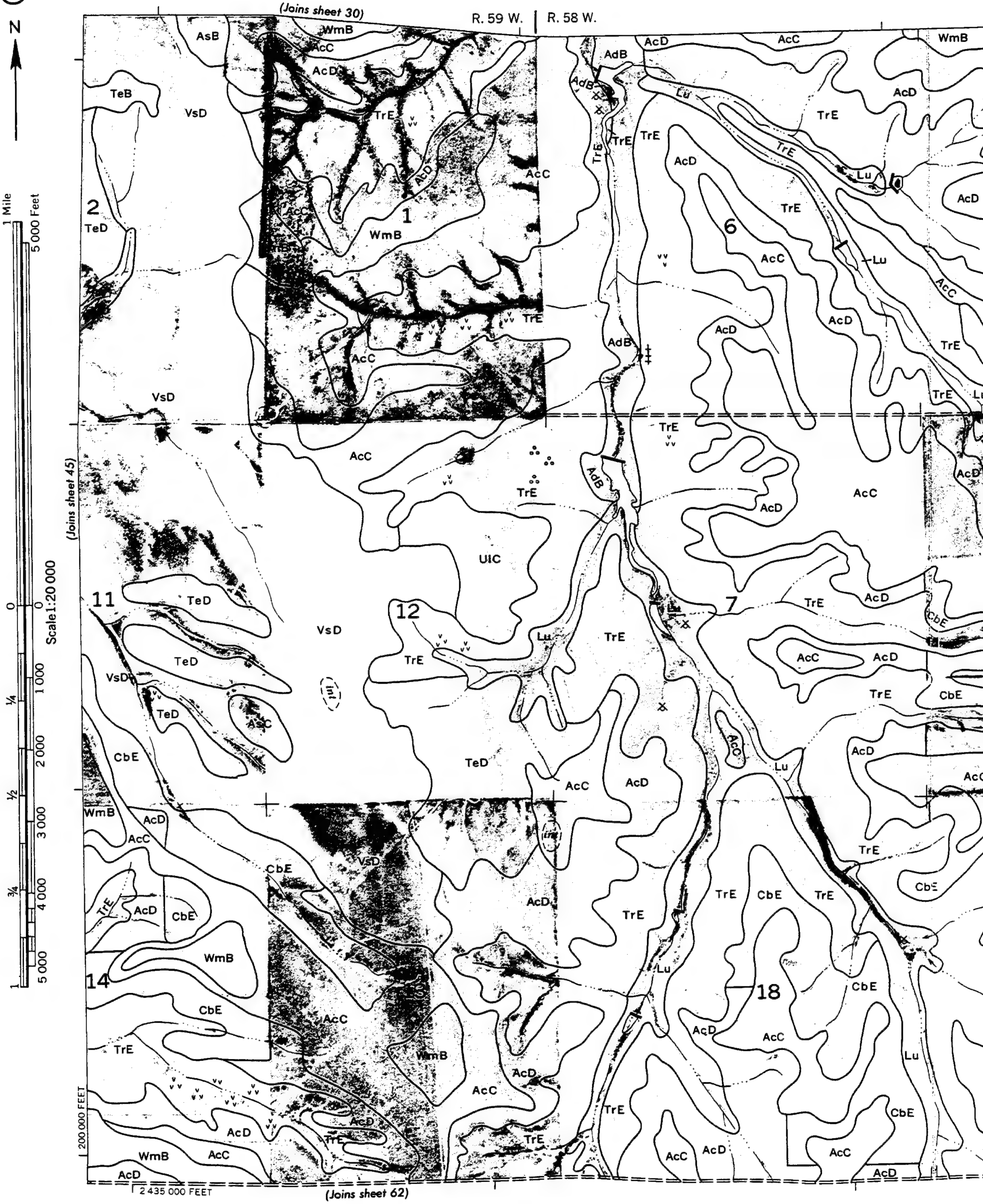

R. 61 W.
R. 60 W.
(Joins sheet 27)
(Joins sheet 44)
(Joins sheet 59)
N
Antelope Creek
Little Antelope Creek
BIJOU CREEK
1
6
7
8
12
13
17
18
HIB
SnB
WmB
NIB
AsB
TuB
TtD
TtB
WuE
HID
AcC
AdB
NIA
Tc
Sm
Lu
int
AvC
WrB
2 385 000 FEET
200 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000

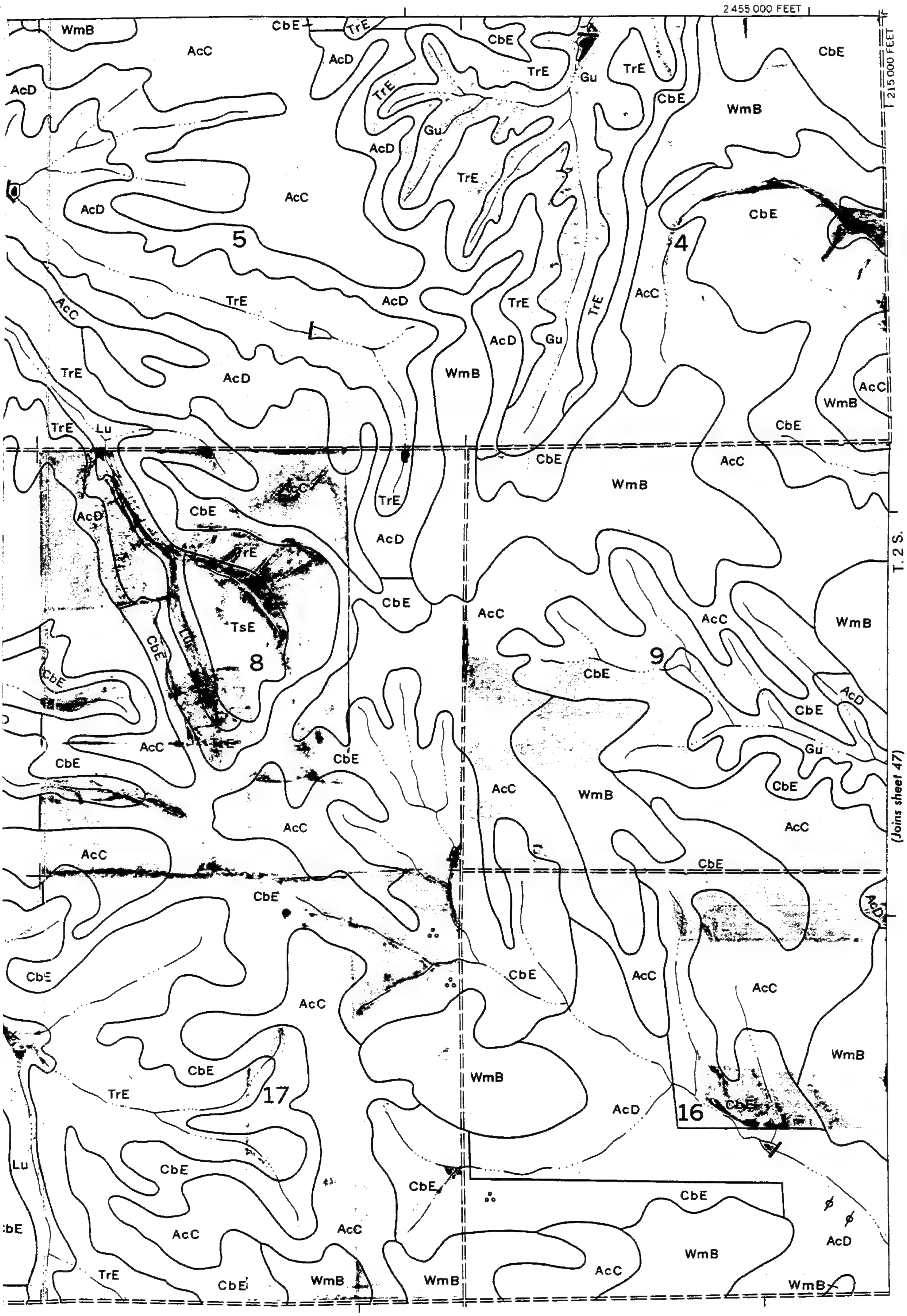

N
1 Mile
5 000 Feet
0
0
¼
1 000
½
2 000
3 000
¾
4 000
1
5 000
Scale 1:20 000
(Joins sheet 28)
(Joins sheet 43)
(Joins sheet 60)
R. 60 W.
1 200 000 FEET
2 390 000 FEET
BIJOU CREEK
4
3
8
9
10
15
16
17
VaD
Sm
HfD
Wt
TtB
AvC
AsB
BoD
VnD
TtD
Bt
Lu
TtD
int
VnB
TuB
AsC
WmB

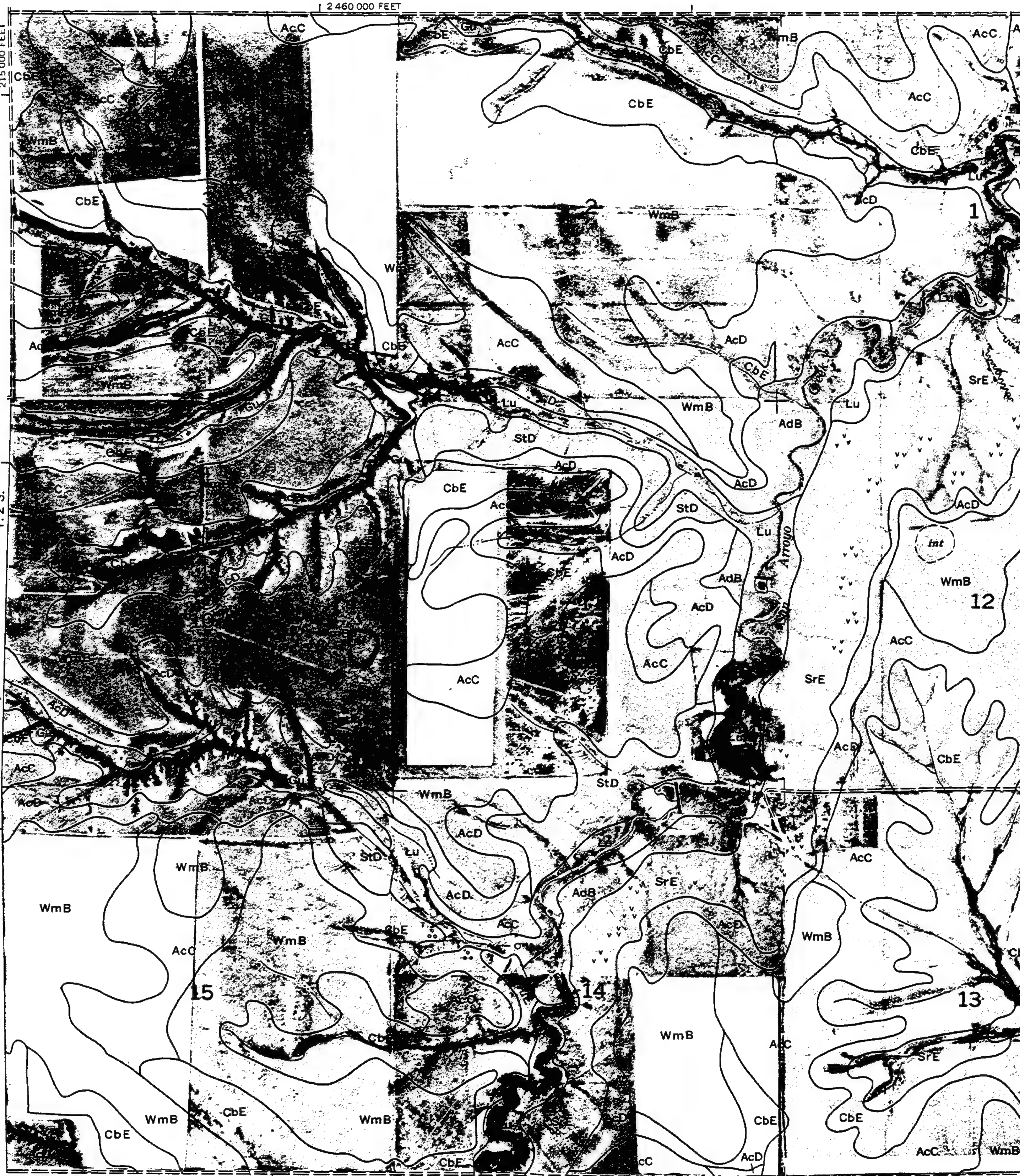

R. 60 W.
2 410 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 45)
Leader
1
2
11
12
13
14
AvC
AsB
TtD
TtB
At
BoD
SnA
WmB
AaB
AcC
Bt
VnD
int
InB

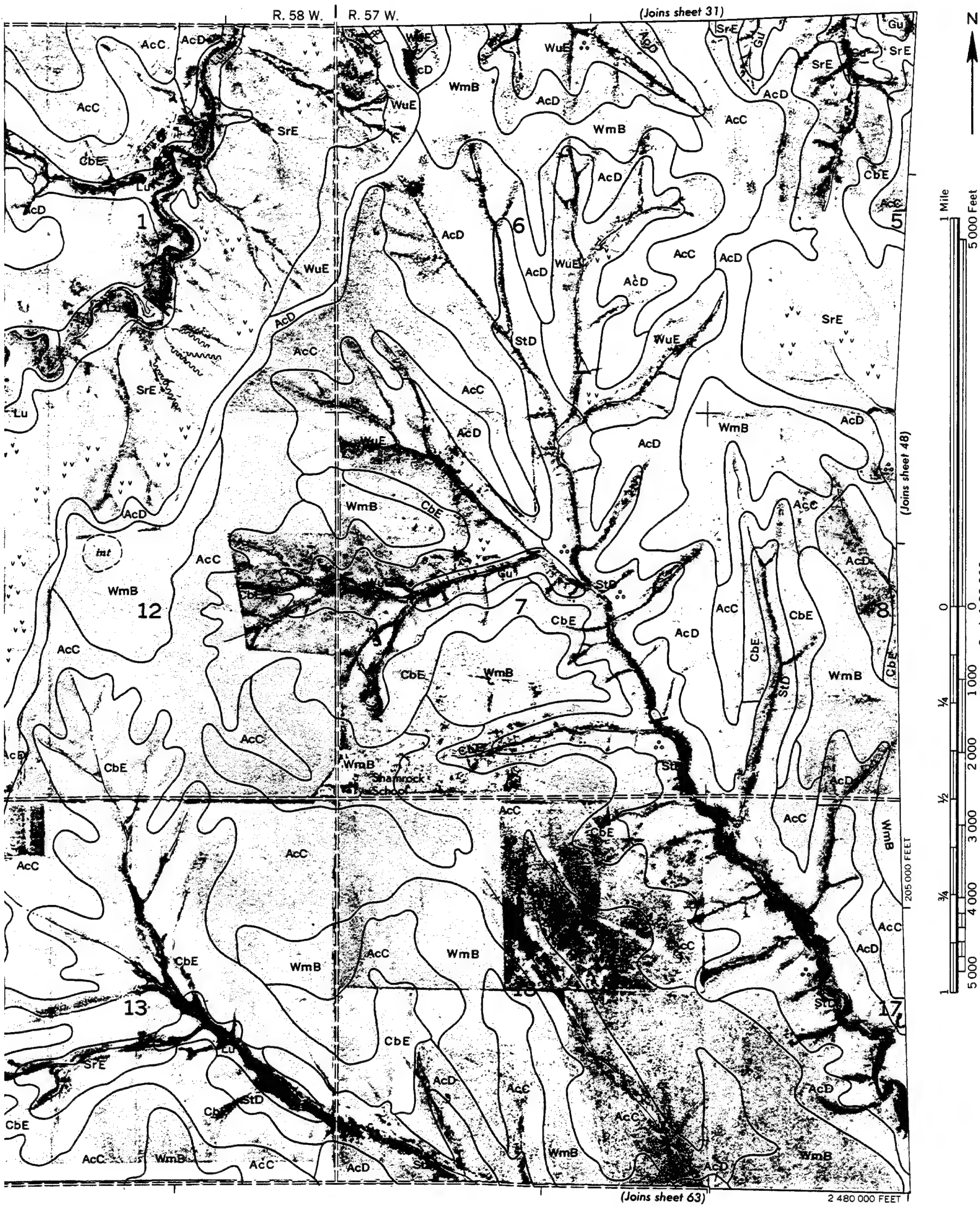

R. 59 W.
2 415 000 FEET
210 000 FEET
T. 2 S.
(Joins sheet 44)
Muddy
Creek
5
6
7
8
17
WrB
AcC
AcD
AdB
Lu
TsE
AsB
AsD
VnB
TeD
NlB
VaD
Bt
AsC
TeB
AvC
VsD
TtB
ReD
UlB
BoD
Te

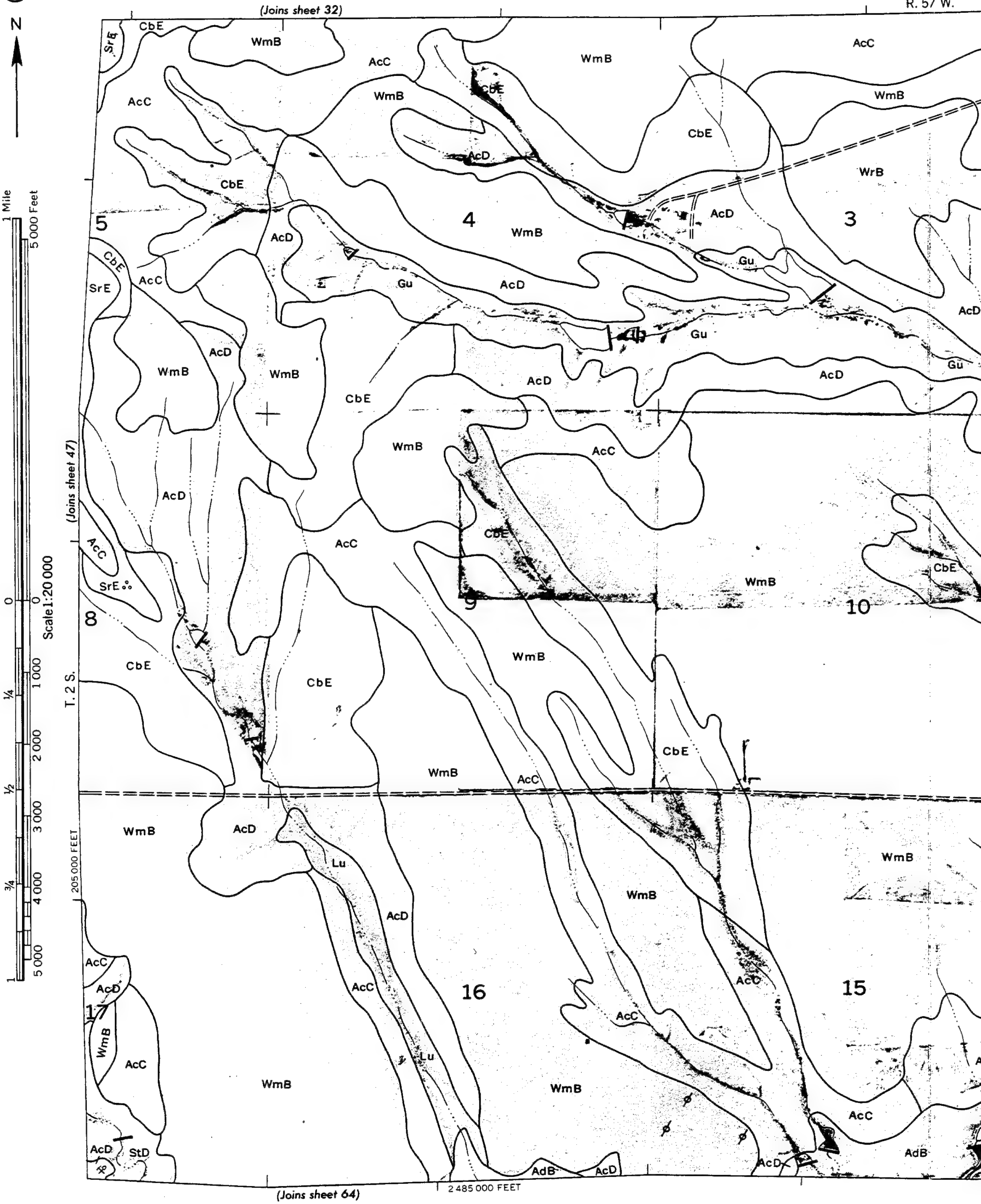

R. 59 W.
(Joins sheet 29)
N
(Joins sheet 46)
(Joins sheet 61)
2 430 000 FEET
200 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
3
2
9
10
11
16
15
14
Muddy
Creek
AvC
TrE
TeD
AsB
TeB
VsD
NIB
VnB
VaD
Lu
int
AcC
AcD
CbE
TsE
AdB
UlB
WmB

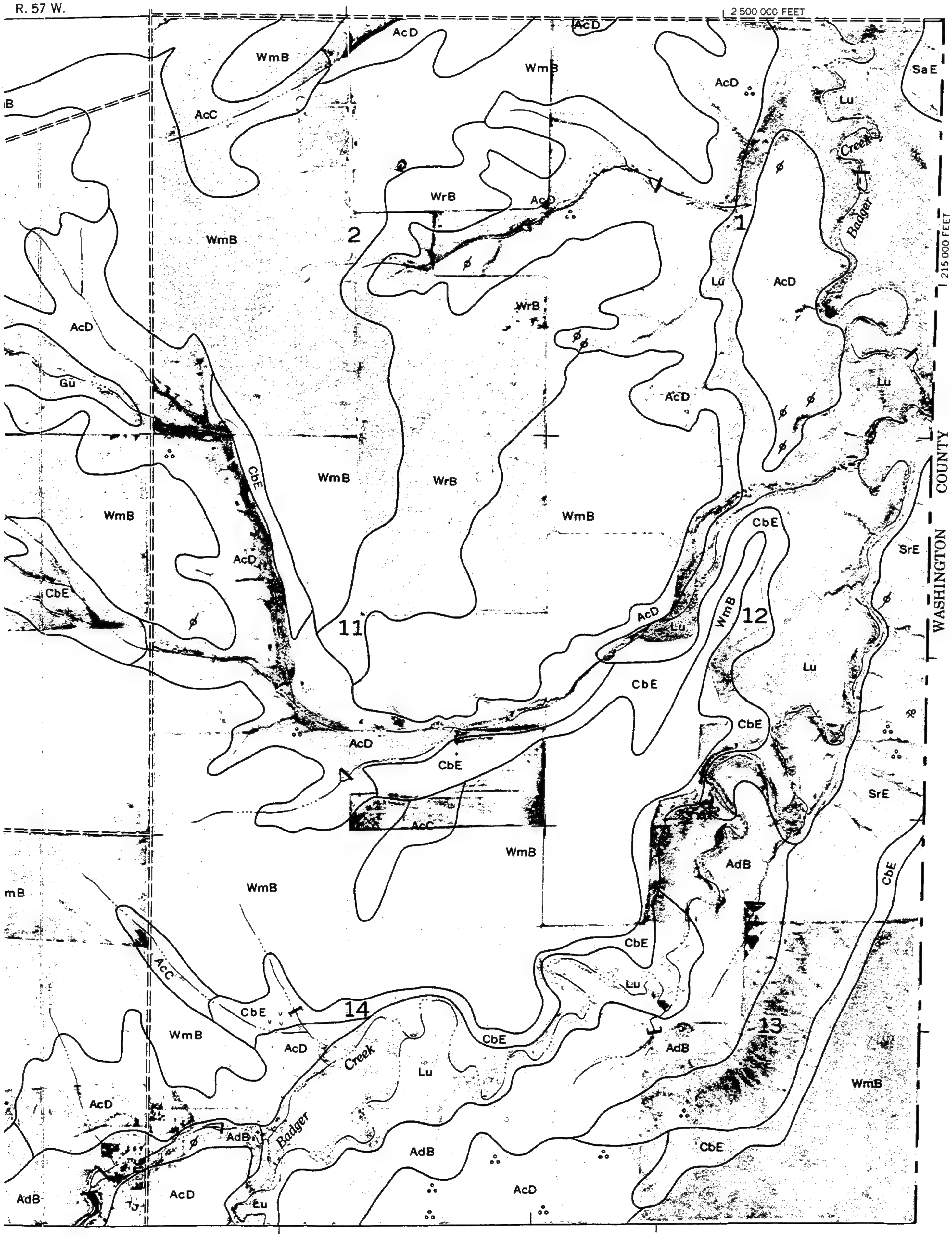

N
(Joins sheet 30)
R. 59 W.
R. 58 W.
(Joins sheet 45)
(Joins sheet 62)
Scale 1:20 000
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
200 000 FEET
2 435 000 FEET
1
2
6
7
11
12
14
18
AsB
WmB
AcC
AcD
TeB
VsD
TrE
AdB
Lu
TeD
UlC
AsC
CbE


2 455 000 FEET
215 000 FEET
T. 2 S.
(Joins sheet 47)
5
4
8
9
17
16
WmB
AcC
AcD
CbE
TrE
Gu
TsE
Lu
AcD
WmB
AcC
CbE

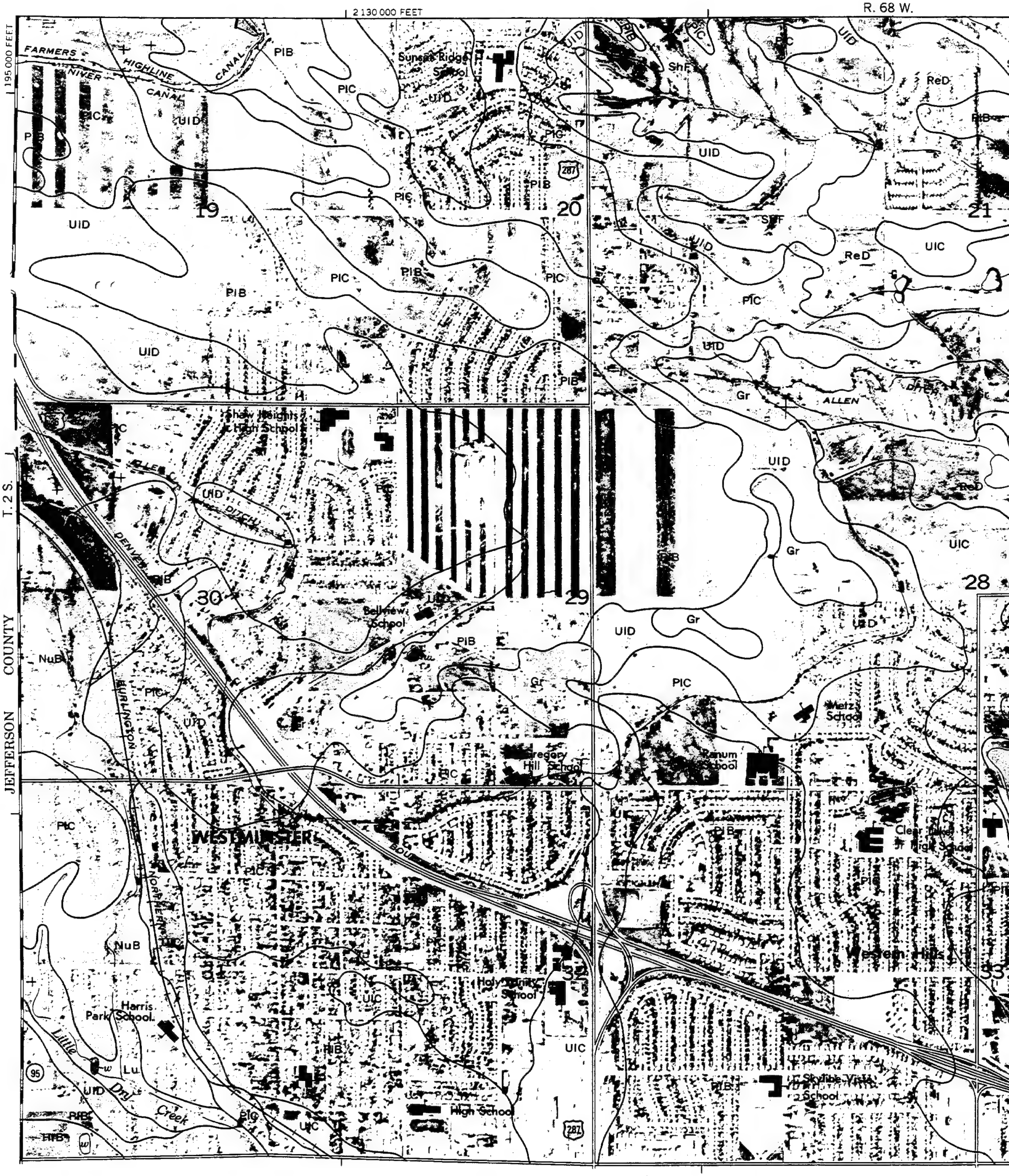

2 460 000 FEET
215 000 FEET
T. 2 S.
(Joins sheet 46)
AcC
CbE
WmB
AcD
AdB
StD
SrE
Lu
Gu
1
2
12
13
14
15
Arroyo
Creek

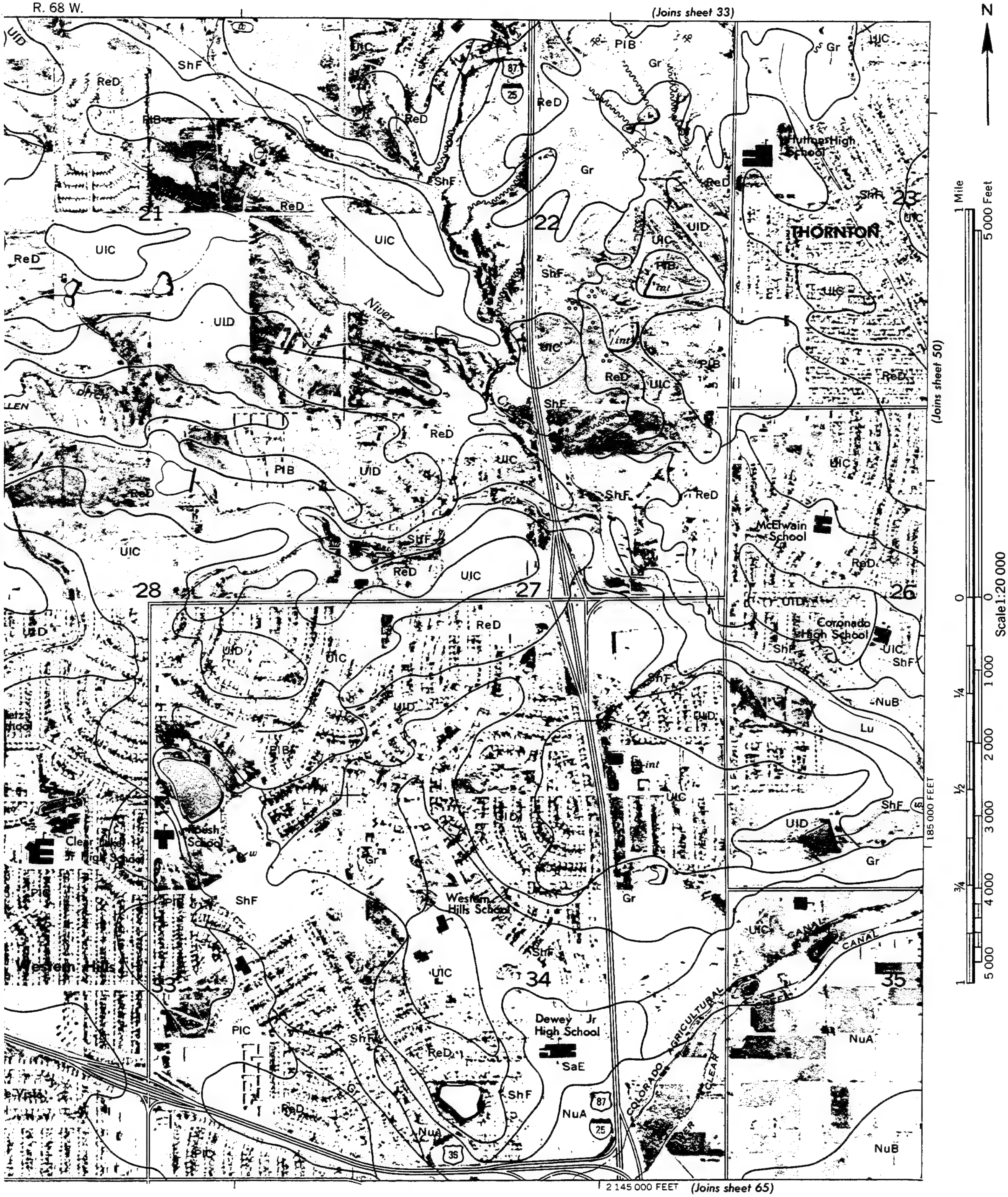

R. 58 W.
R. 57 W.
(Joins sheet 31)
(Joins sheet 48)
(Joins sheet 63)
N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
205 000 FEET
2 480 000 FEET
Shamrock School
AcC
AcD
CbE
Gu
int
Lu
SrE
StD
WmB
WuE
1
5
6
7
8
12
13
17
18

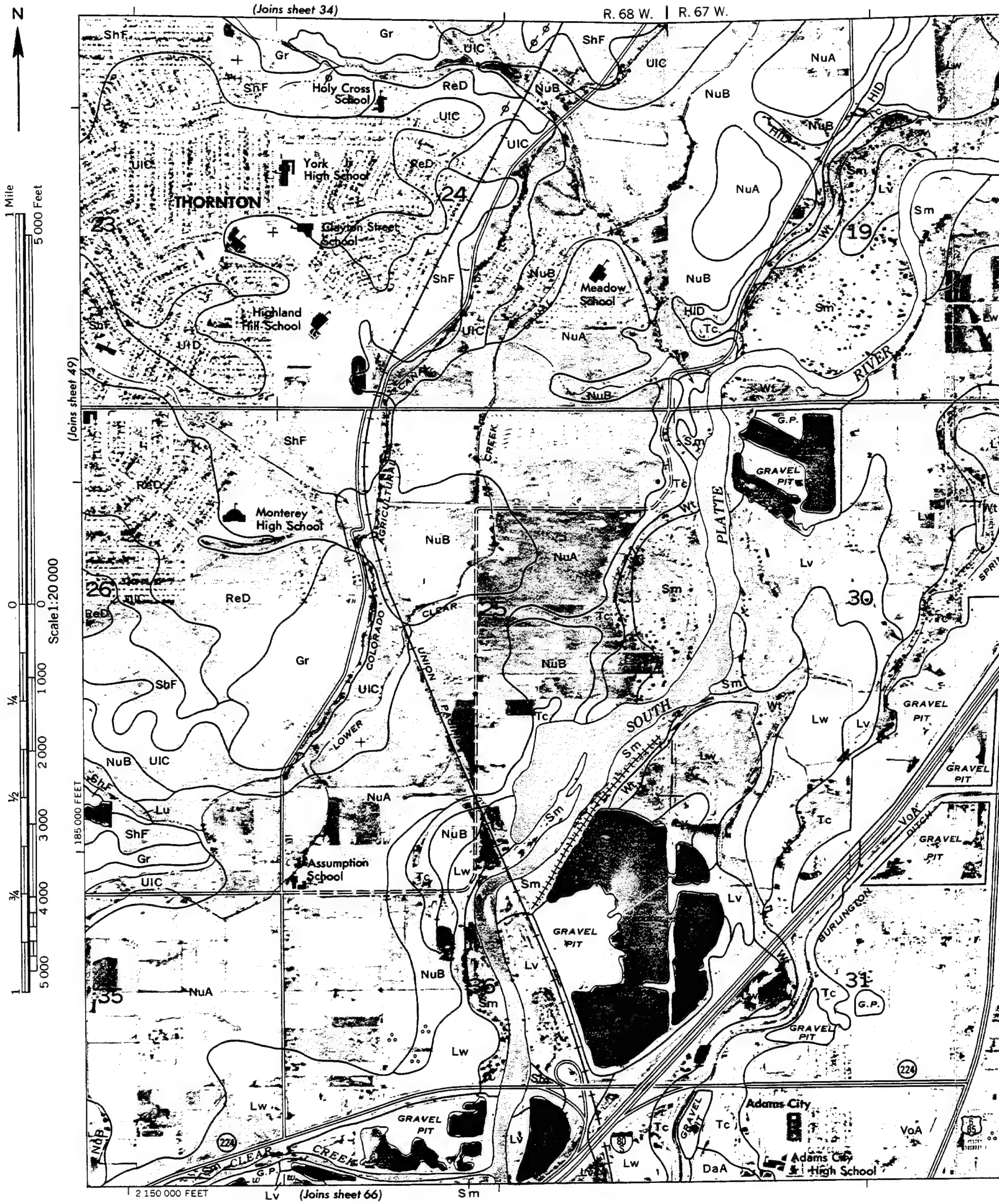

N
(Joins sheet 32)
R. 57 W.
(Joins sheet 47)
(Joins sheet 64)
T. 2 S.
205 000 FEET
2 485 000 FEET
Scale 1:20 000
1 Mile
5 000 Feet
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
3
4
5
8
9
10
15
16
17
AcC
AcD
AdB
CbE
Gu
Lu
SrE
StD
WmB
WrB

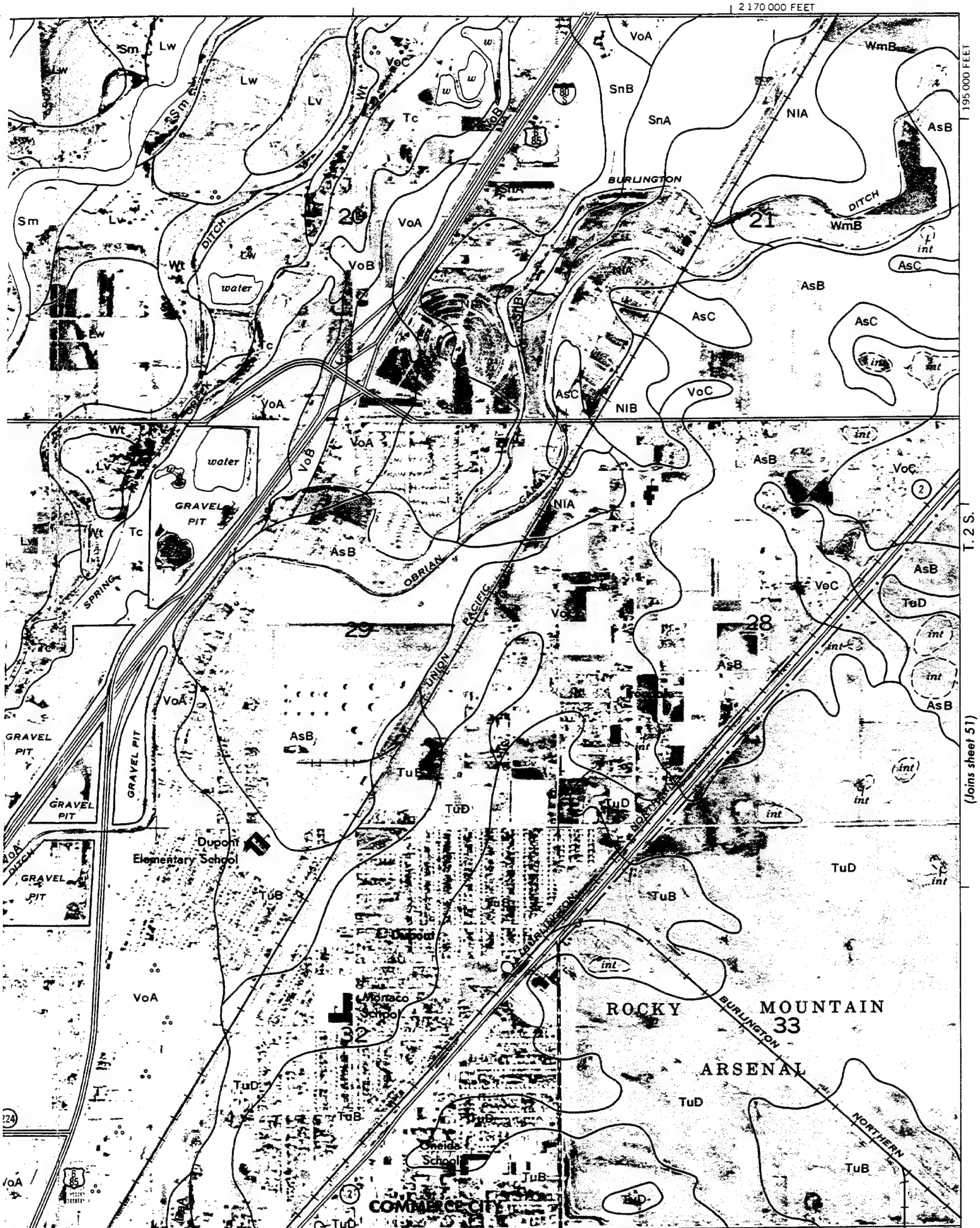


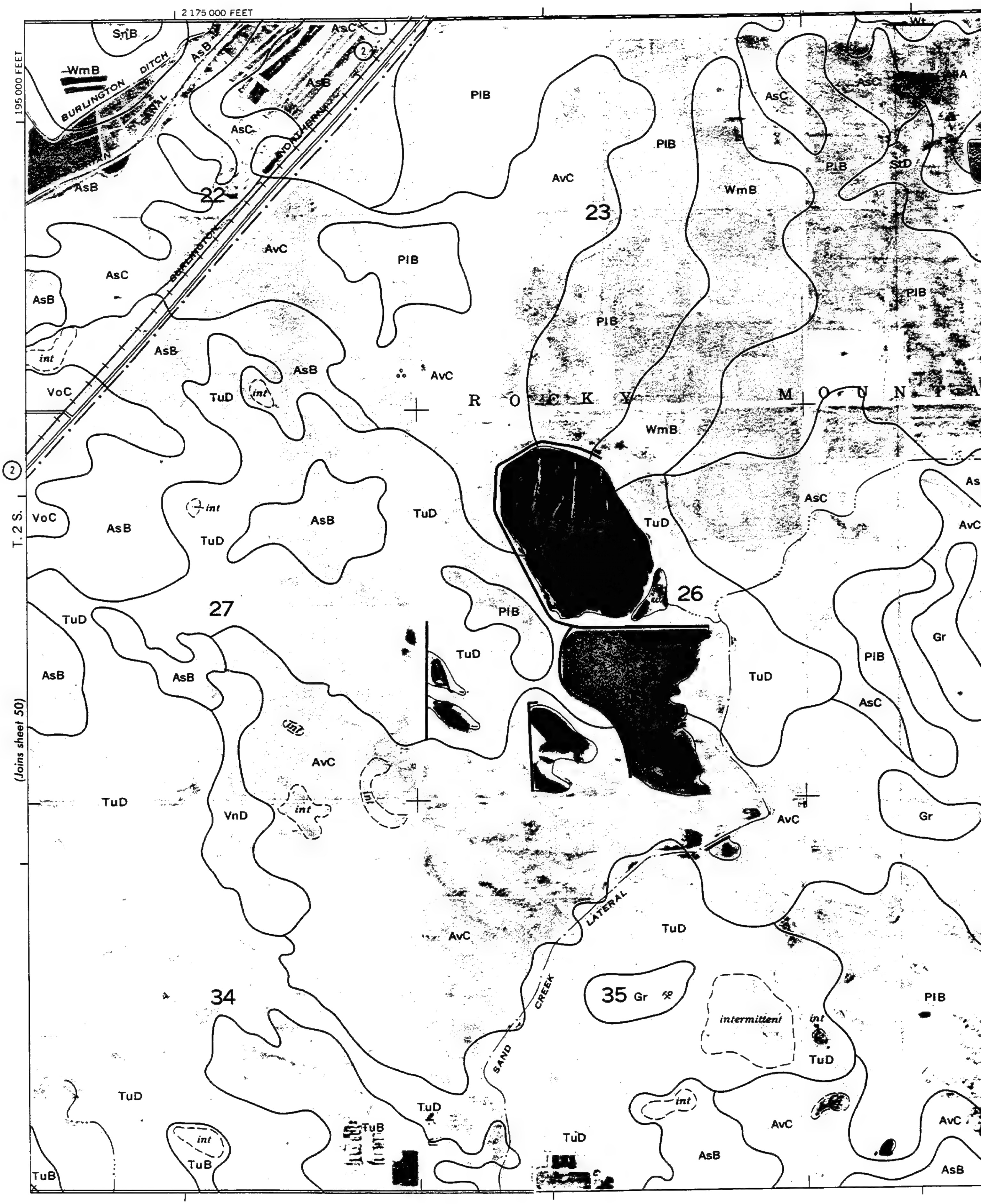
R. 57 W.
2 500 000 FEET
215 000 FEET
WASHINGTON COUNTY
AcD
WmB
AcC
WrB
Lu
SaE
Creek
Badger
1
2
11
12
13
14
Gu
CbE
SrE
AdB

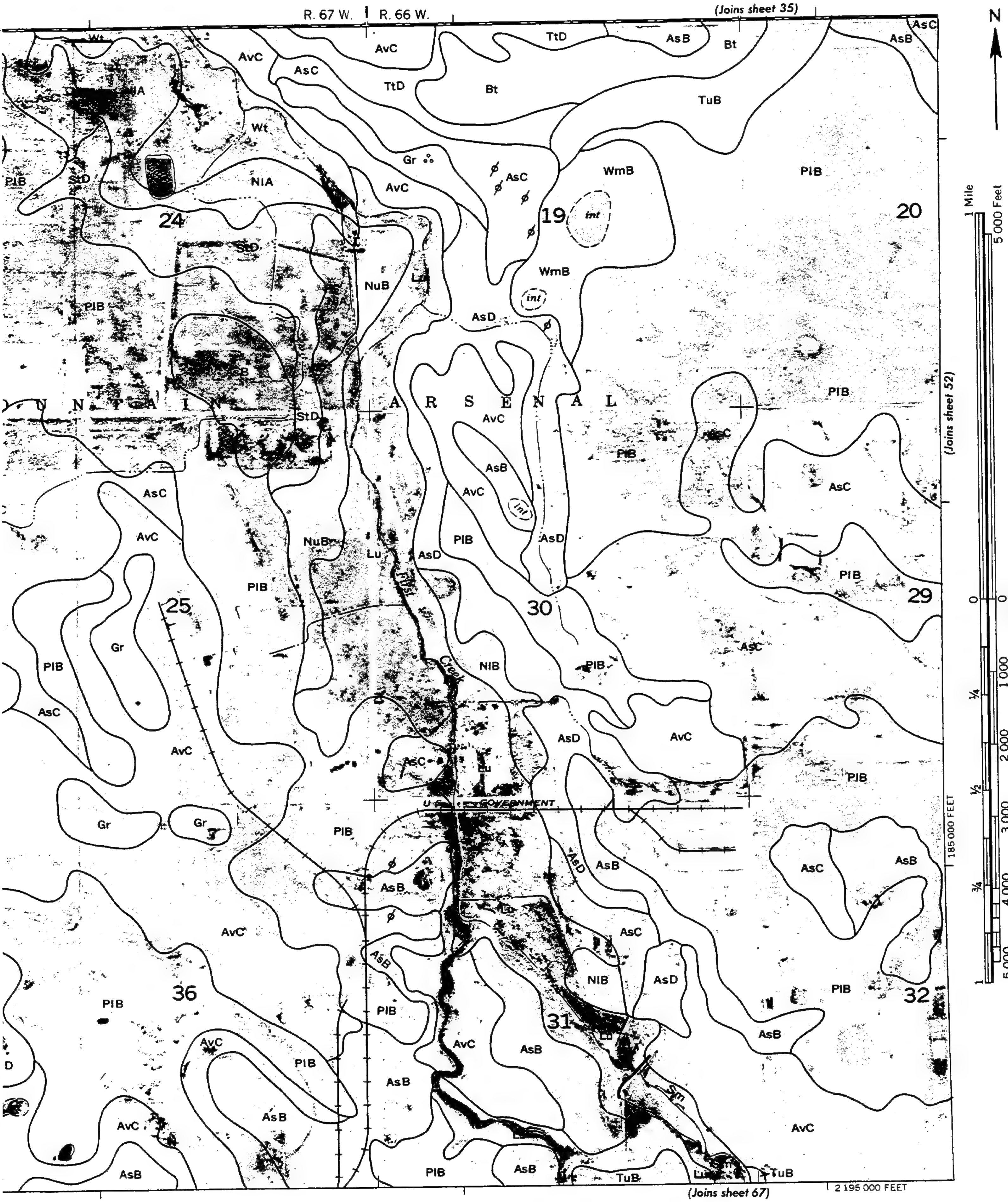

2 130 000 FEET
R. 68 W.
195 000 FEET
T. 2 S.
JEFFERSON COUNTY
FARMERS HIGHLINE CANAL
NIVER CANAL
ALLEN DITCH
DENVER
BURLINGTON NORTHERN
BOULDER
Little Dry Creek
WESTMINSTER
Western Hills
Sunset Ridge School
Shaw Heights High School
Bellview School
Gregory Hill School
Ranum School
Metz School
Clear Lake Jr High School
Holy Trinity School
Harris Park School
Skyline Vista School
High School
19
20
21
28
29
30
31
32
33
287
95
PIB
PIC
UID
UIC
ShF
ReD
Gr
NuB
Lu

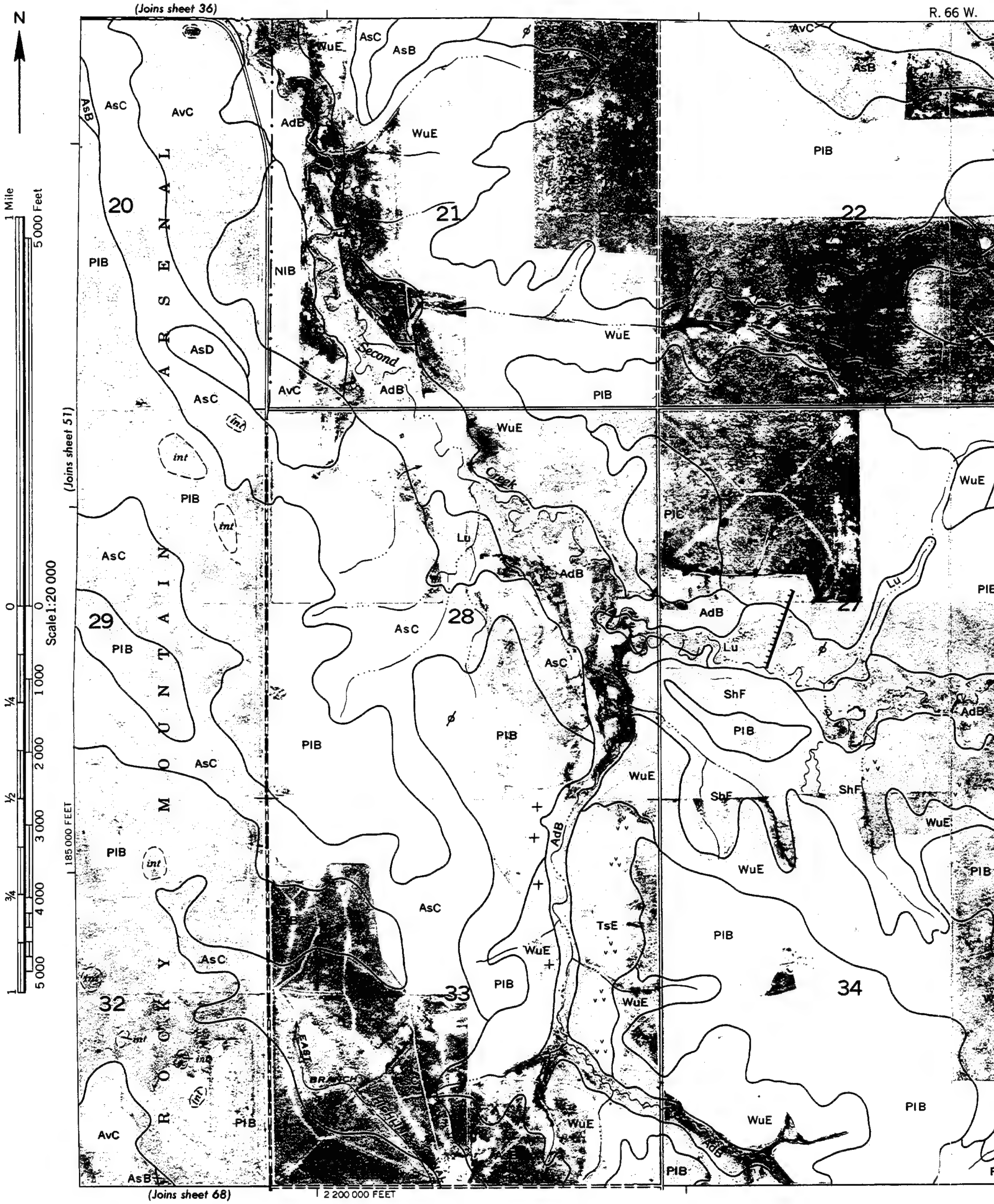

R. 68 W.
(Joins sheet 33)
N
(Joins sheet 50)
(Joins sheet 65)
2 145 000 FEET
185 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
THORNTON
Hutton High School
McElwain School
Coronado High School
Western Hills School
Dewey Jr High School
Clear Lake Jr High School
Western Hills
River
Creek
COLORADO AGRICULTURAL CANAL
CANAL
21
22
23
26
27
28
33
34
35
ShF
ReD
PlB
Gr
UlC
UlD
NuA
NuB
Lu
SaE
PlC

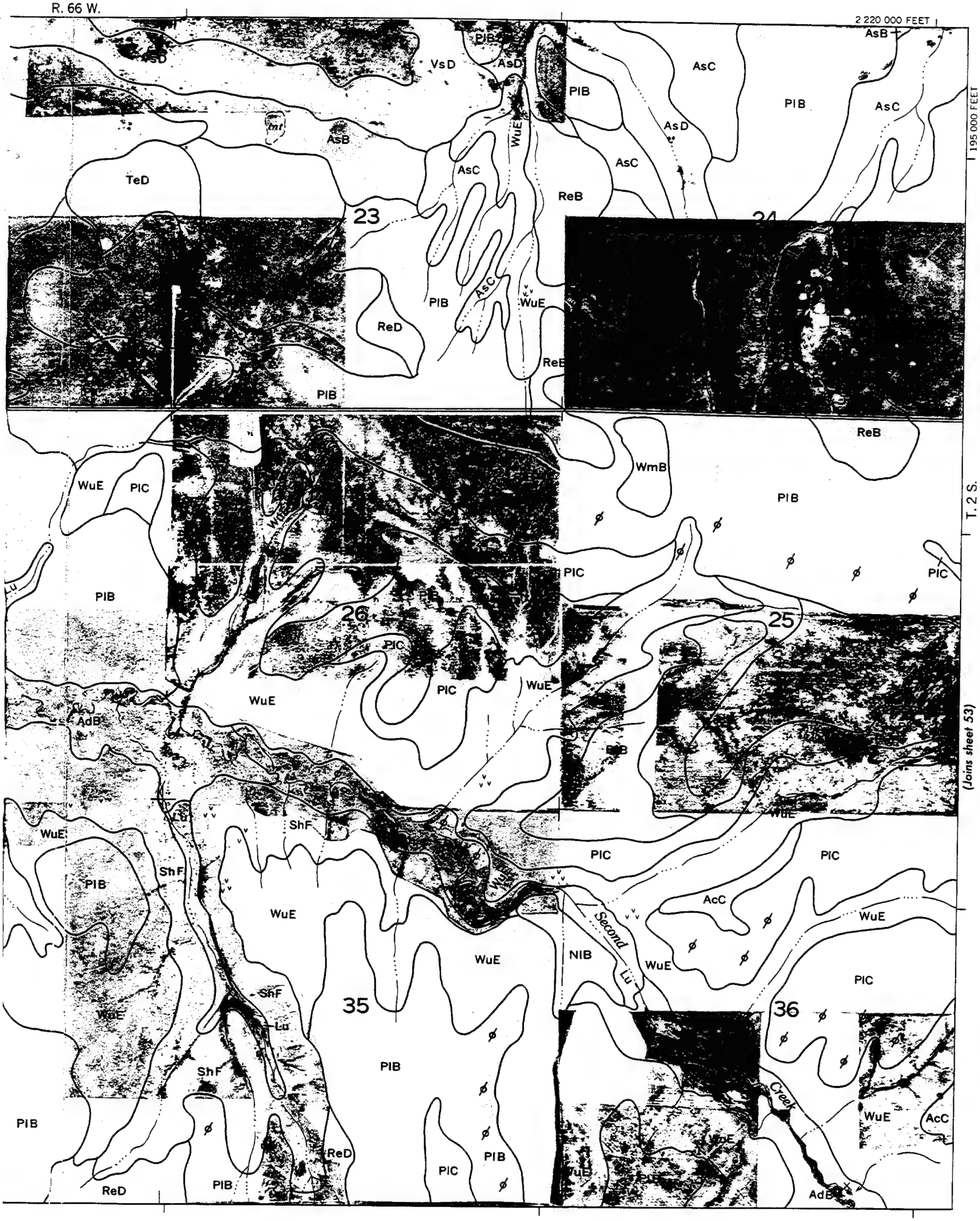

N
(Joins sheet 34)
R. 68 W.
R. 67 W.
(Joins sheet 49)
(Joins sheet 66)
1 Mile
5 000 Feet
0
Scale 1:20 000
1 000
2 000
3 000
4 000
5 000
¼
½
¾
1
185 000 FEET
2 150 000 FEET
THORNTON
Holy Cross School
York High School
Clayton Street School
Highland Hill School
Meadow School
Monterey High School
Assumption School
Adams City
Adams City High School
SOUTH PLATTE RIVER
AGRICULTURAL CANAL
COLORADO
UNION PACIFIC
CLEAR CREEK
LOWER CLEAR CREEK
BURLINGTON DITCH
GRAVEL PIT
G.P.
23
24
19
26
25
30
35
36
31
224
80
85
ShF
Gr
UlC
ReD
NuB
NuA
UlD
SbF
Lu
HlD
Tc
Sm
Lv
Lw
Wt
VoA
DaA

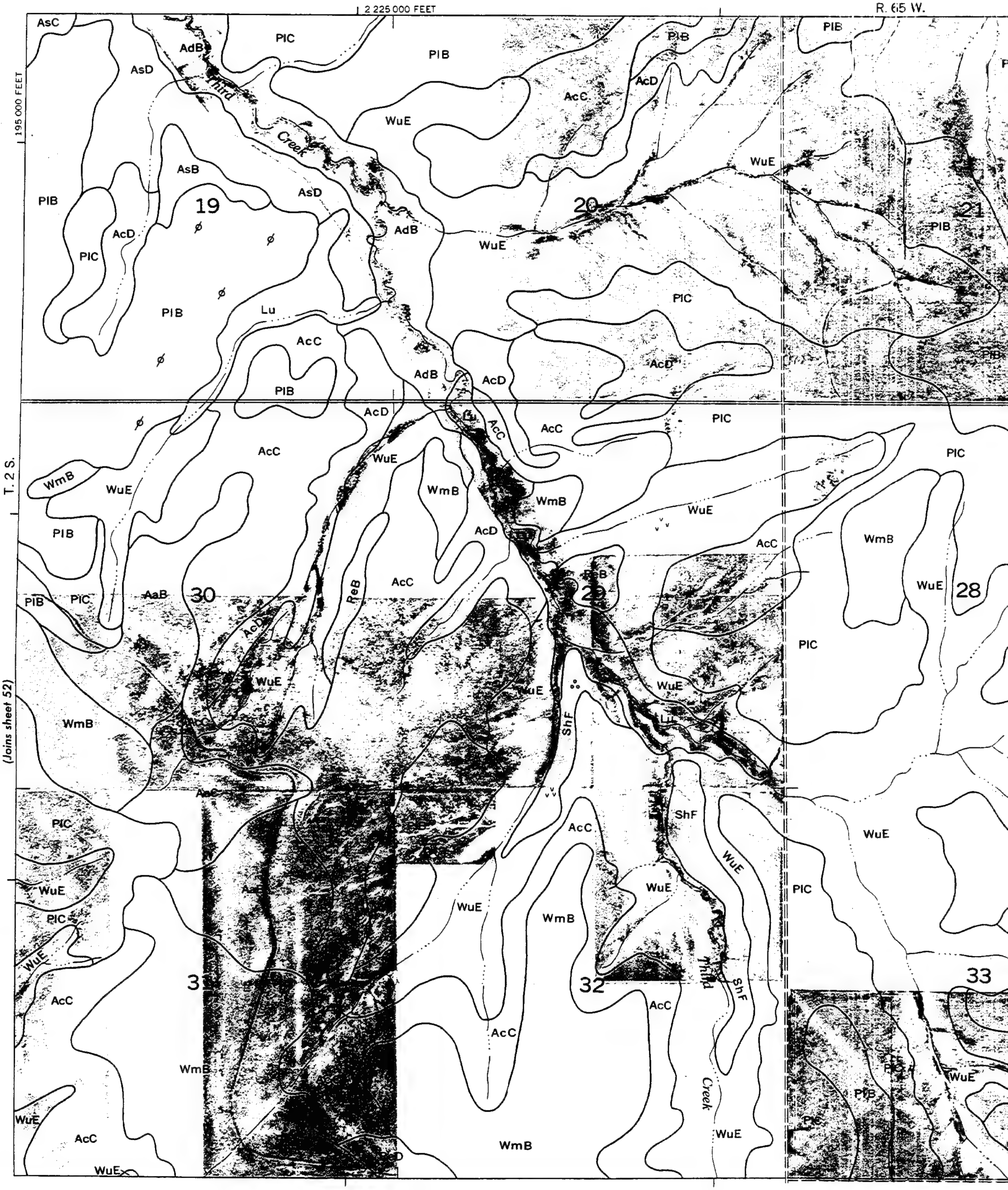

2 170 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 51)
20
21
28
29
32
33
BURLINGTON
DITCH
OBRIAN
SPRING
UNION PACIFIC
NORTHERN
GRAVEL PIT
water
Dupont Elementary School
Dupont
Monaco School
Oneida School
COMMERCE CITY
ROCKY MOUNTAIN ARSENAL
Sm
Lw
Lv
Wt
Tc
VoA
VoB
VoC
SnA
SnB
NIA
NIB
AsB
AsC
WmB
TuB
TuD
int
w

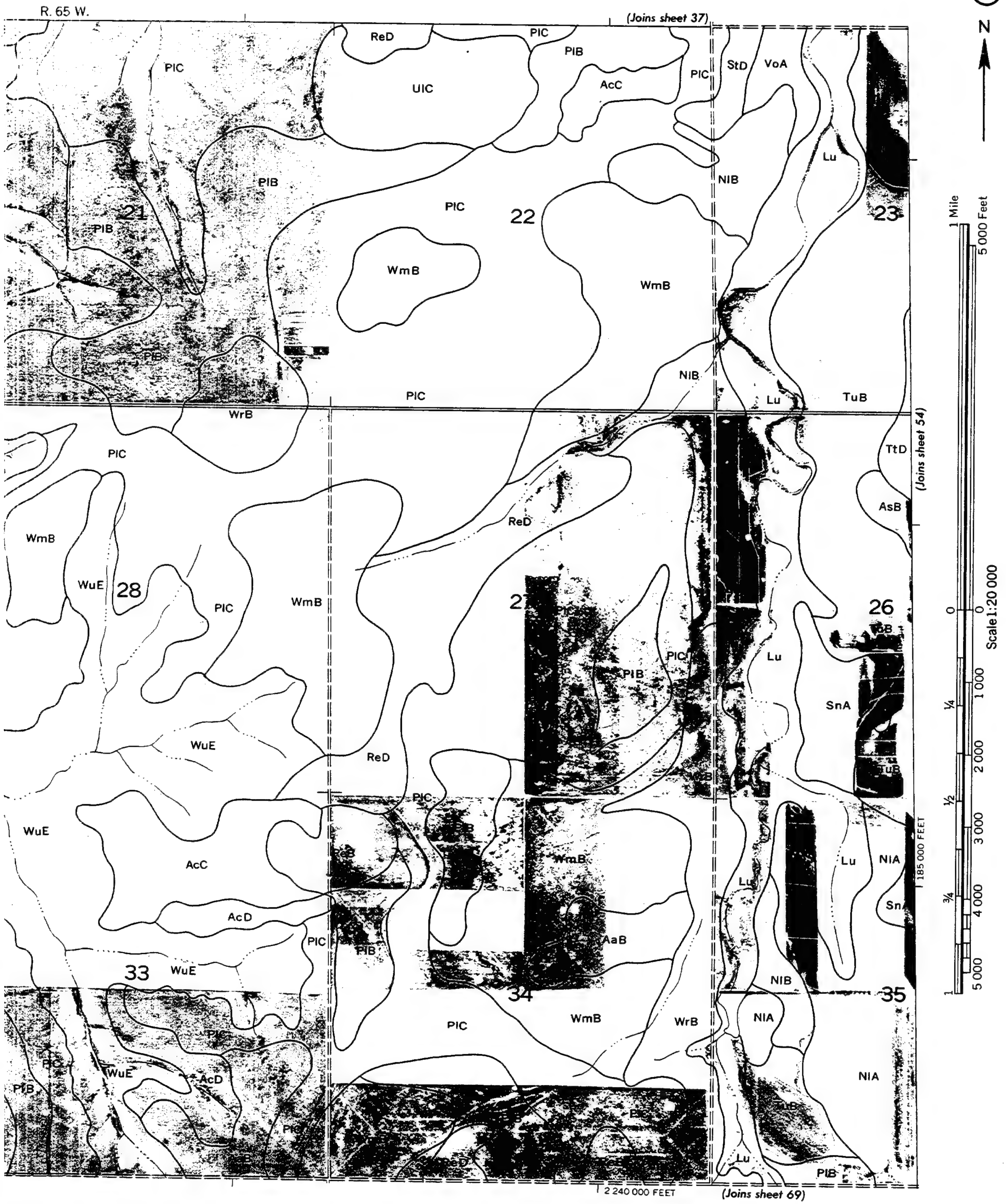

2 175 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 50)
BURLINGTON DITCH
O'BRIAN CANAL
NORTHERN
BURLINGTON
R O C K Y M O U N T A
SAND CREEK LATERAL
intermittent
int
22
23
26
27
34
35
SnB
WmB
AsB
AsC
PlB
AvC
StD
VoC
TuD
VnD
TuB
Gr
Wt
2

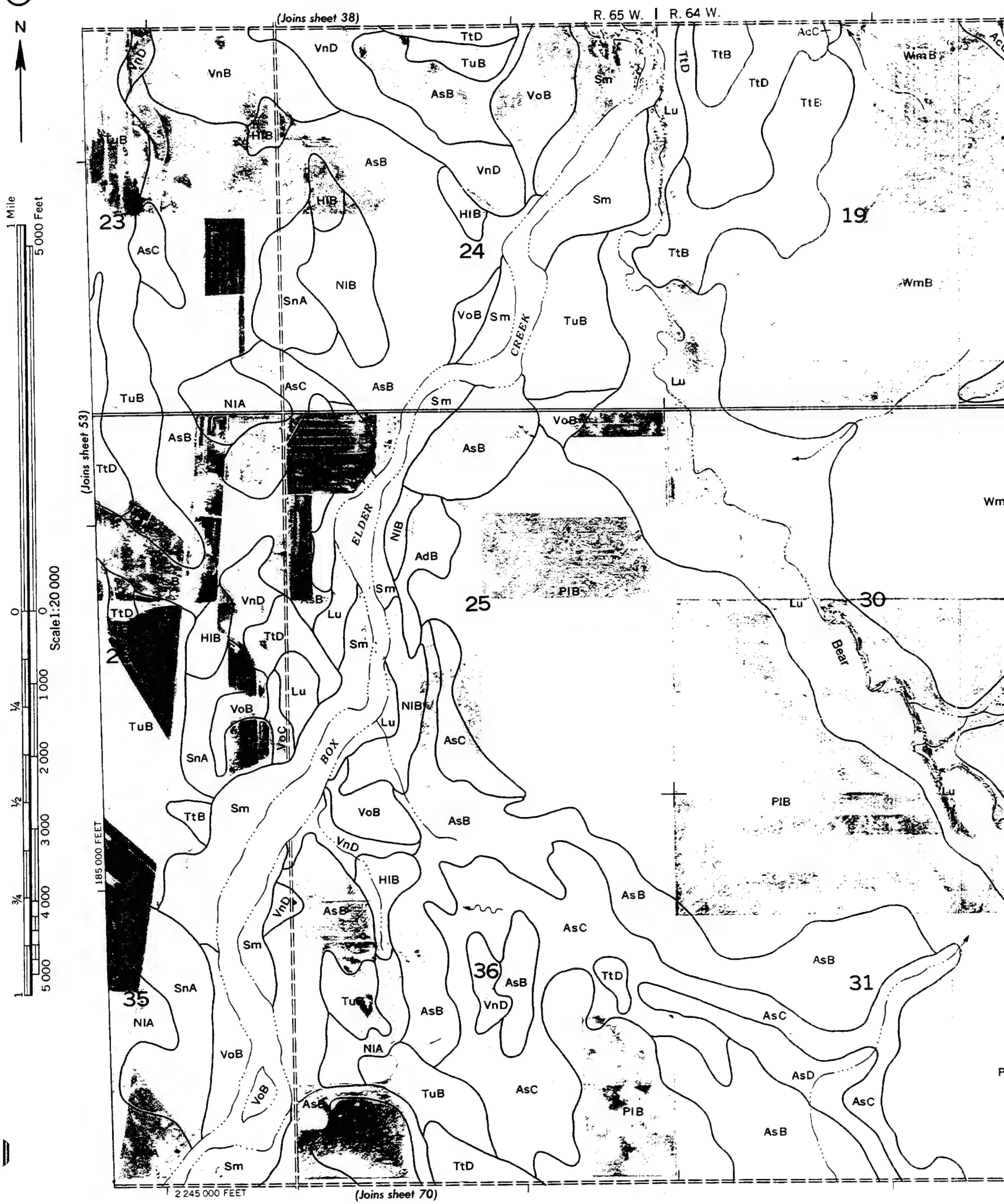

R. 67 W.
R. 66 W.
(Joins sheet 35)
N
(Joins sheet 52)
(Joins sheet 67)
1 Mile
5 000 Feet
Scale 1:20 000
185 000 FEET
2 195 000 FEET
19
20
24
25
29
30
31
32
36
U.S. GOVERNMENT
ARSENAL
First Creek

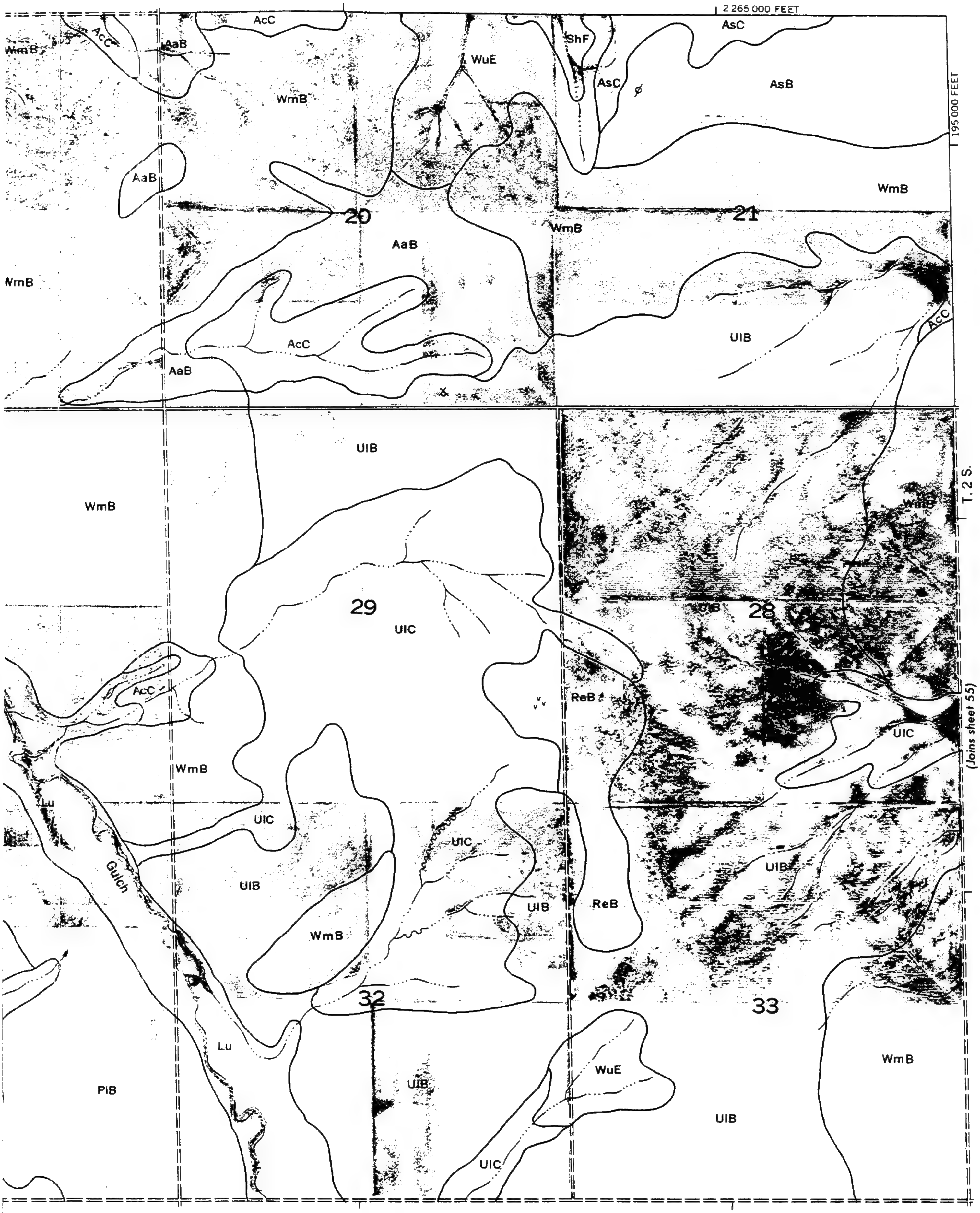

N
(Joins sheet 36)
(Joins sheet 51)
(Joins sheet 68)
R. 66 W.
1 Mile
5 000 Feet
Scale 1:20 000
185 000 FEET
2 200 000 FEET
ROCKY MOUNTAIN ARSENAL
Second Creek
EAST BRANCH
20
21
22
27
28
29
32
33
34
AsB
AsC
AvC
AsD
AdB
WuE
PlB
NlB
PlC
Lu
ShF
TsE
int

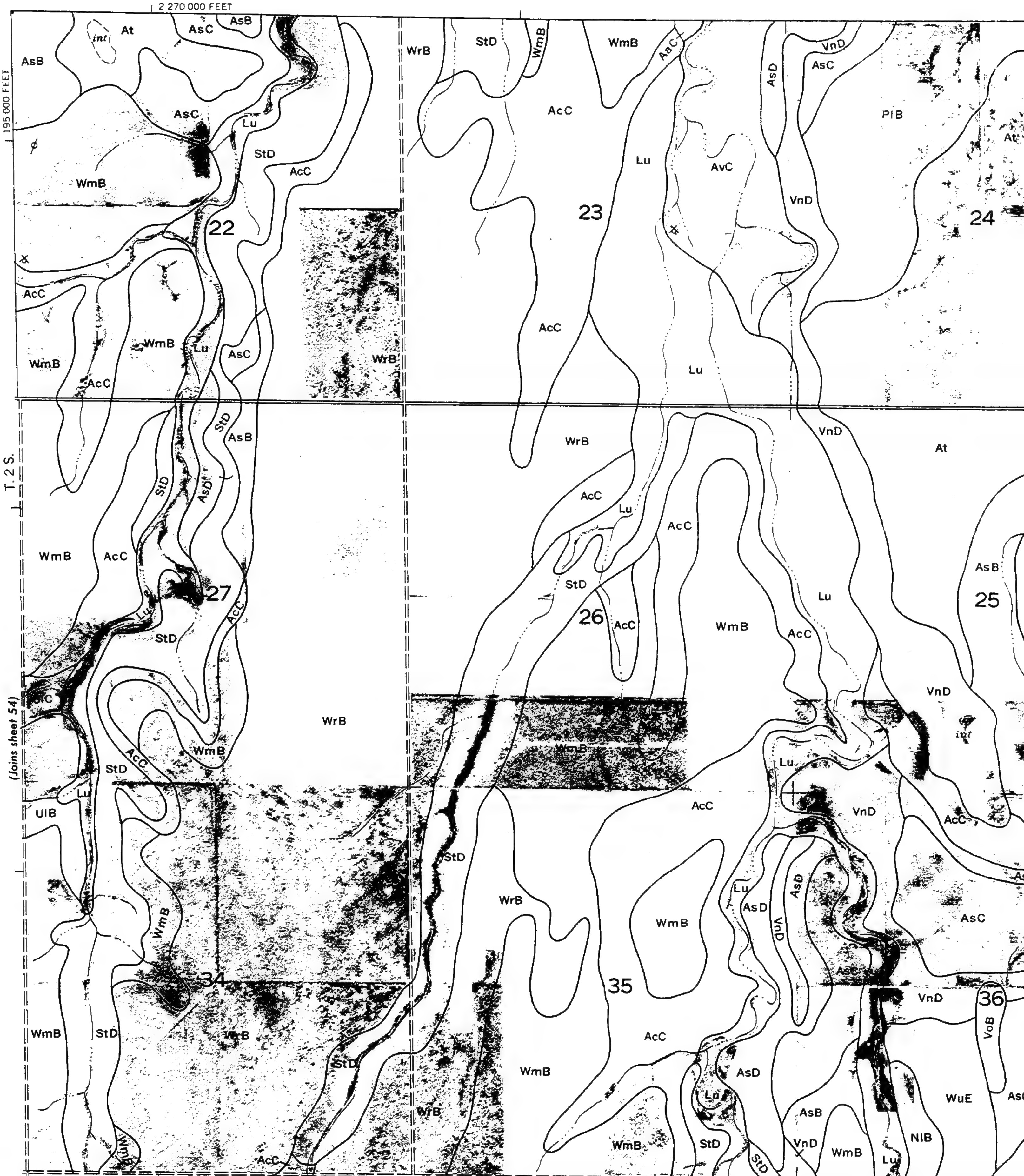

R. 66 W.
2 220 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 53)
AsB
AsD
VsD
PlB
AsC
WuE
AsB
TeD
ReB
23
24
ReD
ReB
WmB
PlC
PlC
Lu
26
25
AdB
ShF
AcC
Second
NlB
Creek
35
36
ReD

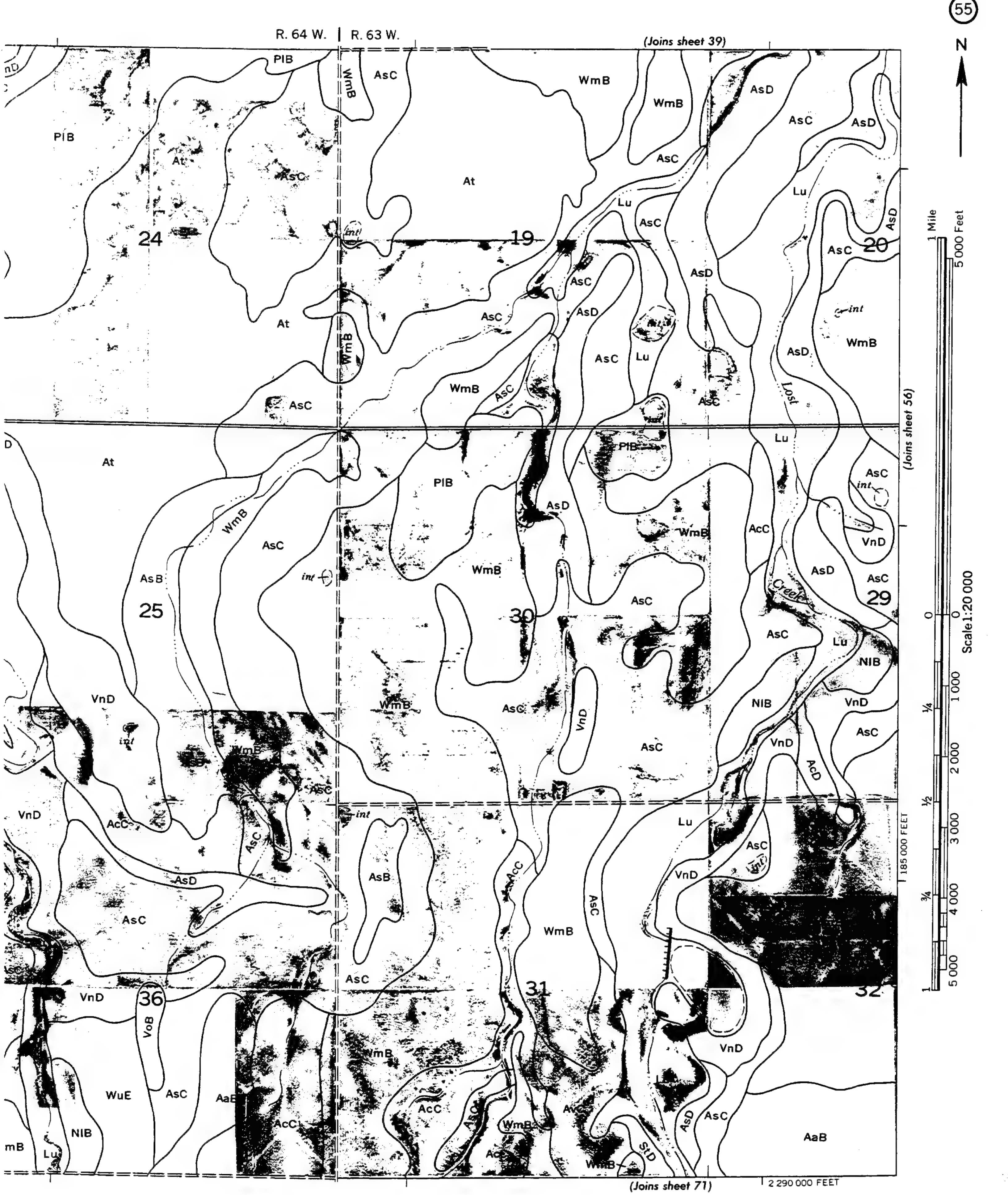

2 225 000 FEET
R. 65 W.
195 000 FEET
T. 2 S.
(Joins sheet 52)
Third Creek
19
20
21
28
29
30
32
33
AsC
AdB
AsD
PIC
PIB
AcD
AcC
WuE
AsB
Lu
WmB
ReB
AaB
ShF
Third Creek

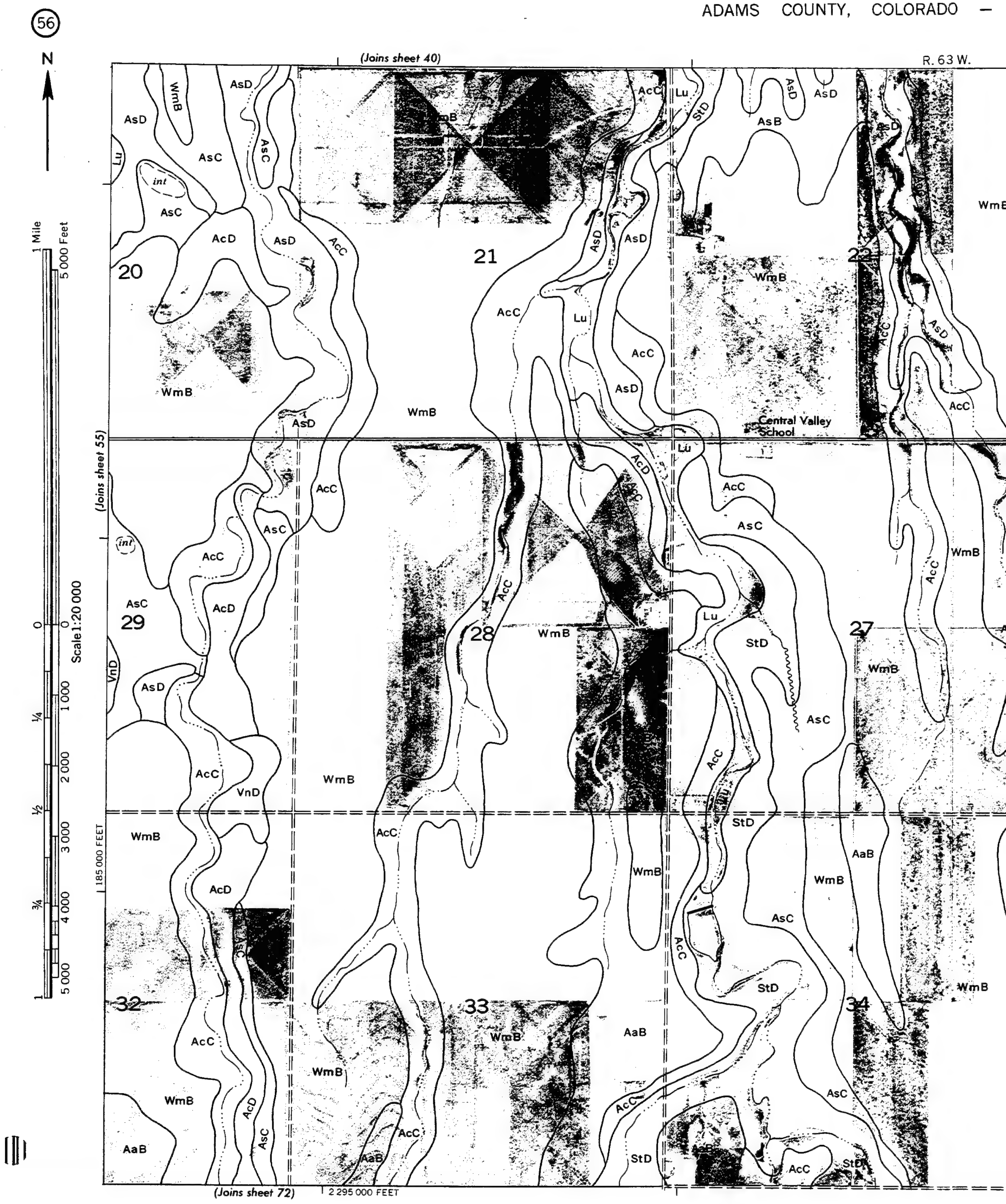

R. 65 W.
(Joins sheet 37)
(Joins sheet 54)
(Joins sheet 69)
N
2 240 000 FEET
185 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
21
22
23
26
27
28
33
34
35
ReD
PlC
PlB
UlC
AcC
StD
VoA
Lu
NlB
WmB
WrB
TuB
TtD
AsB
WuE
SnA
NlA
AcD
AaB

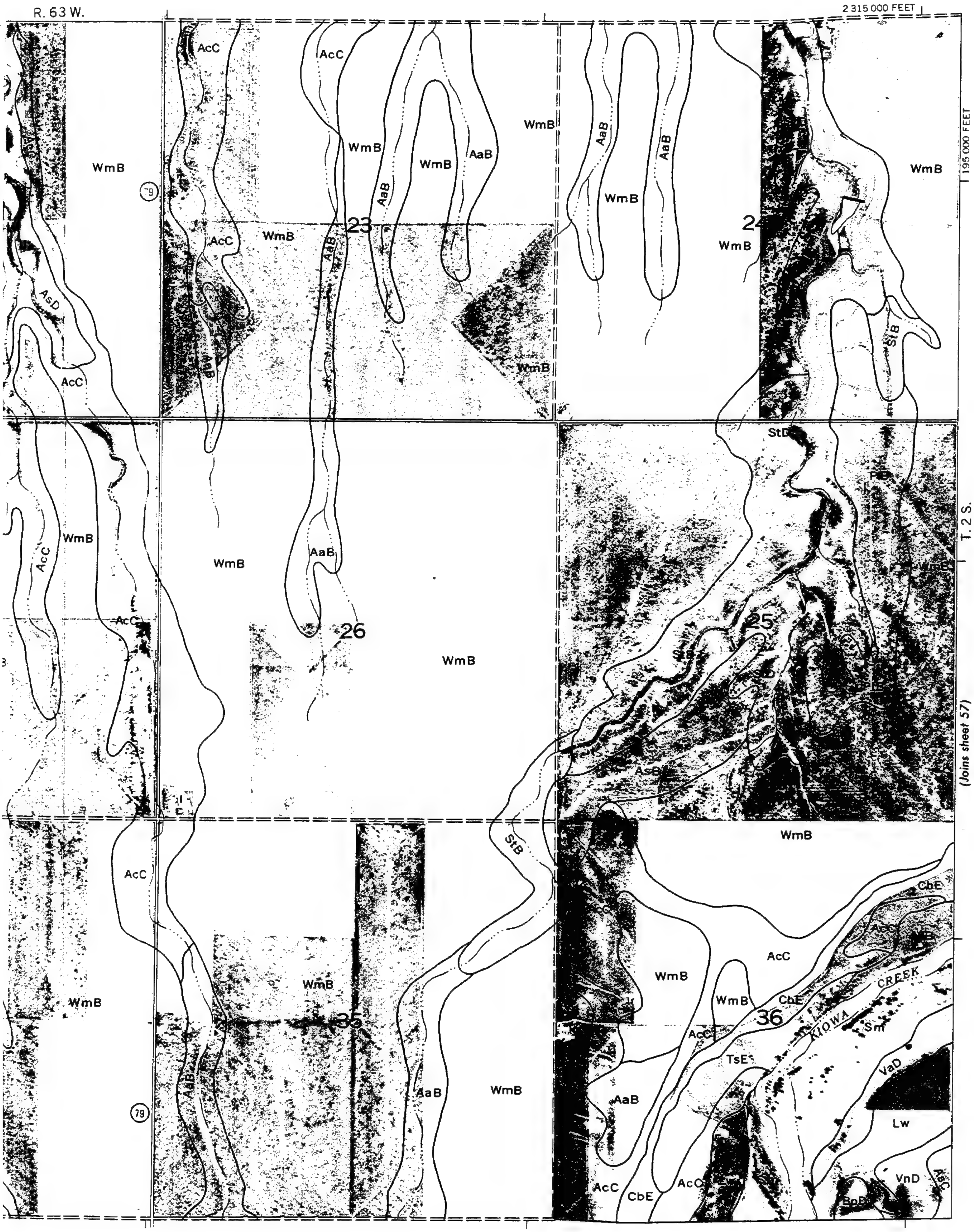

N
1 Mile
5 000 Feet
0
Scale 1:20 000
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 38)
(Joins sheet 53)
(Joins sheet 70)
R. 65 W.
R. 64 W.
185 000 FEET
2 245 000 FEET
ELDER
CREEK
BOX
Bear
19
23
24
25
30
31
35
36
VnD
VnB
HlB
TtD
TuB
AsB
VoB
Sm
TtB
AcC
WmB
Lu
NlB
SnA
AsC
VnD
NlA
TuB
AdB
PlB
TtD
HlB
VoC
TtB
AsD
Wm

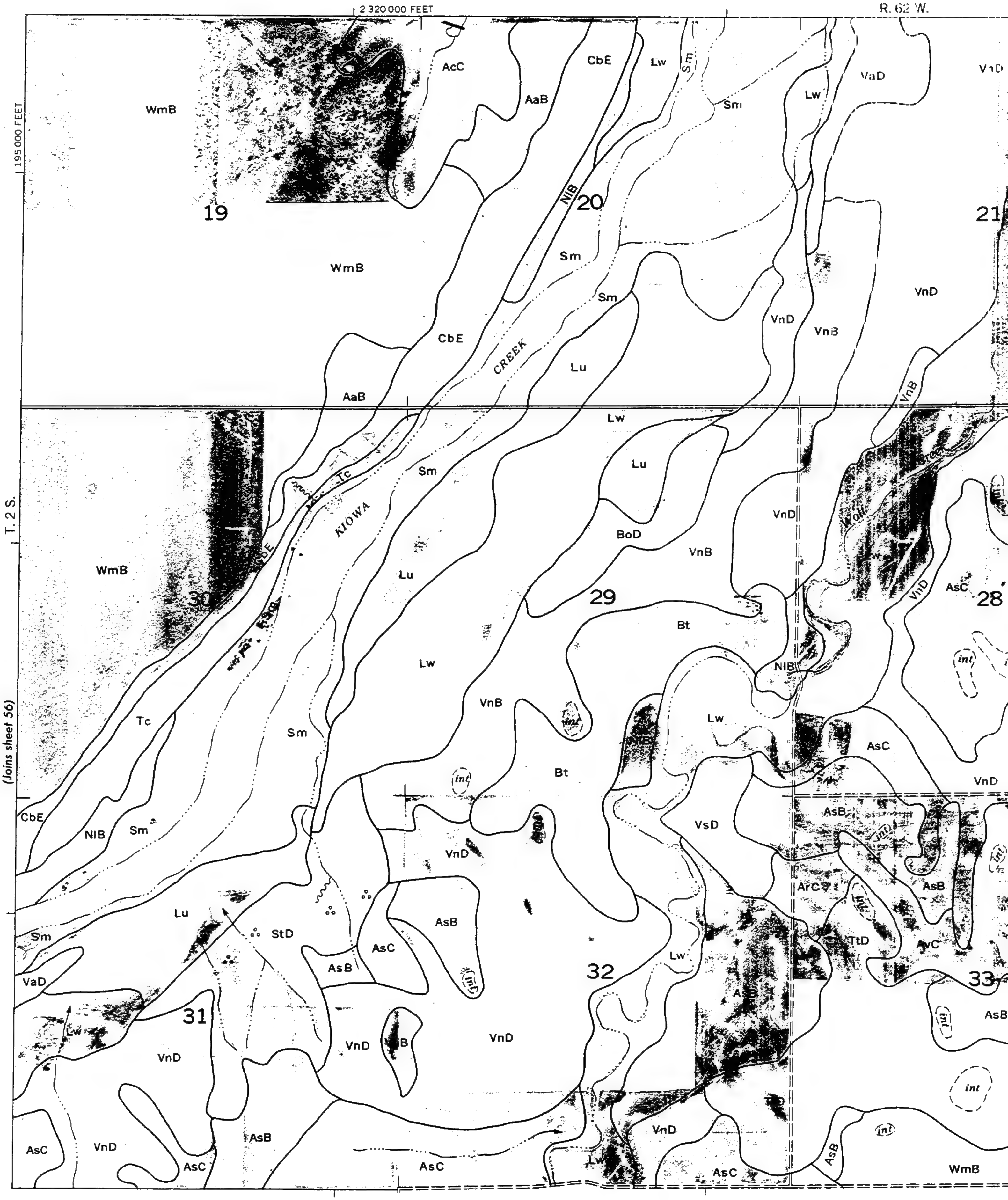

2 265 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 55)
20
21
28
29
32
33
AcC
AaB
WmB
WuE
ShF
AsC
AsB
UIB
UIC
ReB
Lu
Gulch
PIB

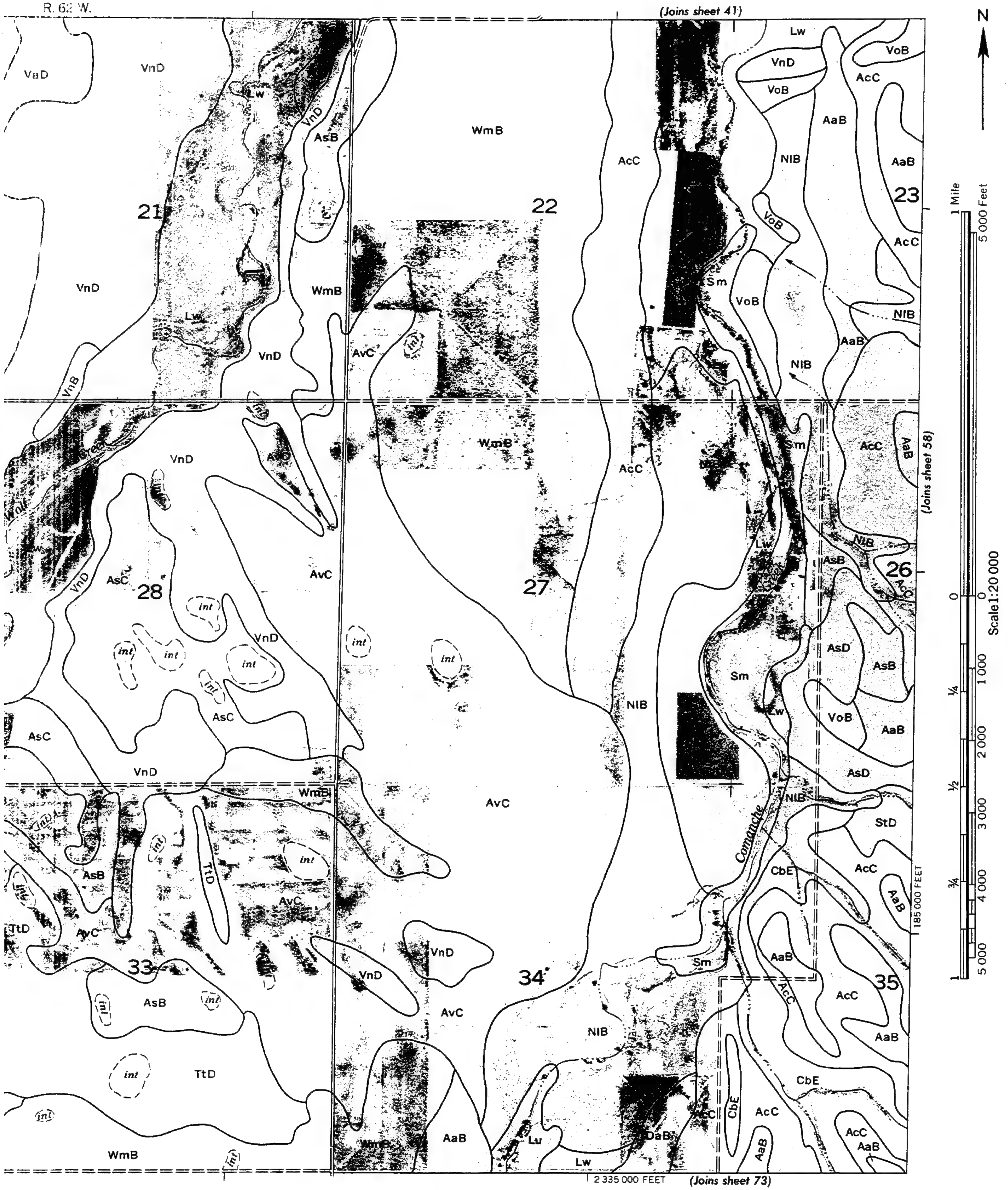

2 270 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 54)
22
23
24
25
26
27
34
35
36
AsB
At
AsC
int
WmB
Lu
StD
AcC
WrB
AaC
AsD
VnD
AvC
PlB
AsB
UlB
AsD
VoB
WuE
NlB

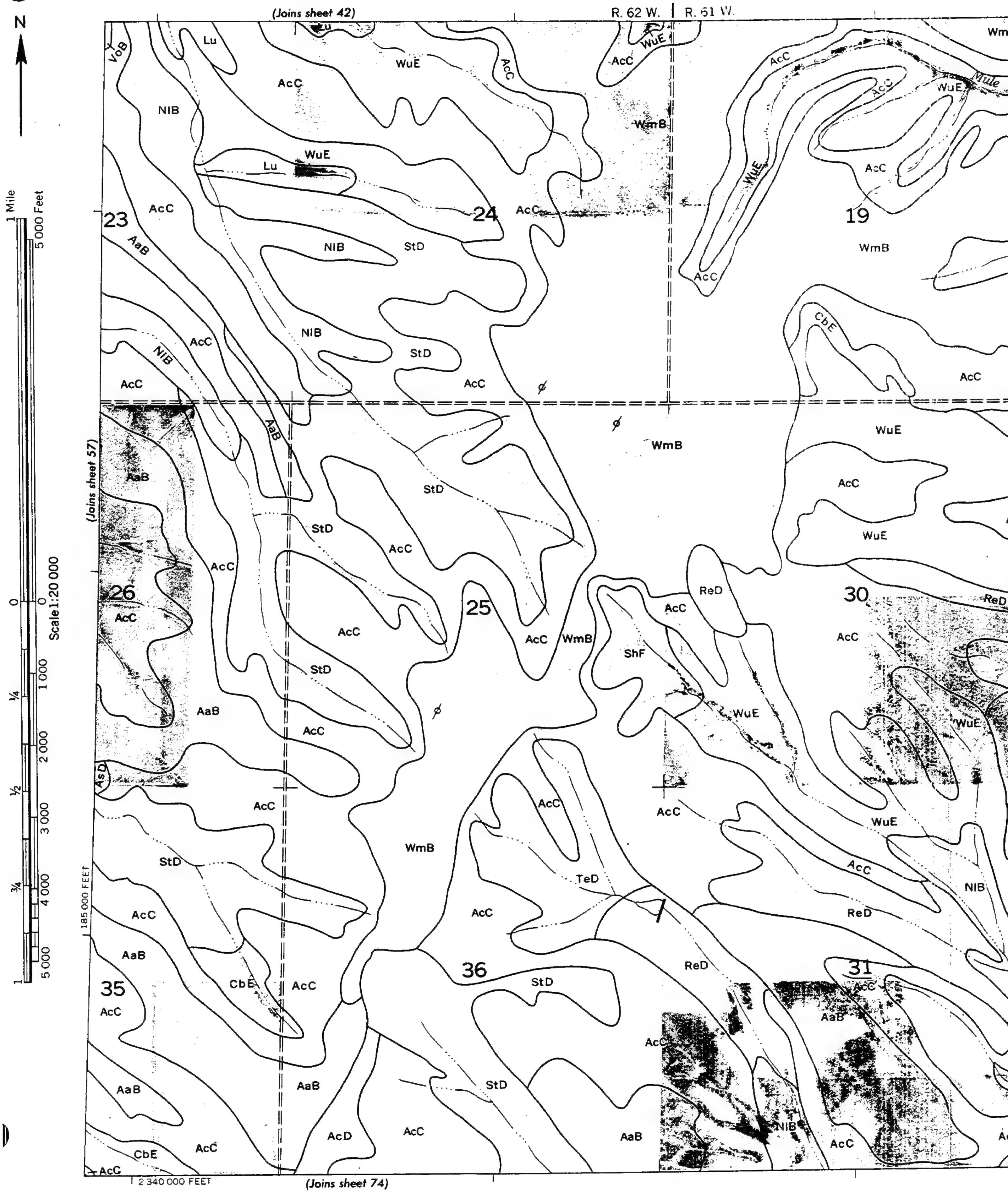

55
R. 64 W.
R. 63 W.
(Joins sheet 39)
(Joins sheet 56)
(Joins sheet 71)
N
24
19
20
25
30
29
36
31
32
Lost Creek
185 000 FEET
2 290 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
PlB
AsC
WmB
AsD
At
Lu
AsB
VnD
AcC
NlB
AcD
VoB
WuE
AaB
StD
int

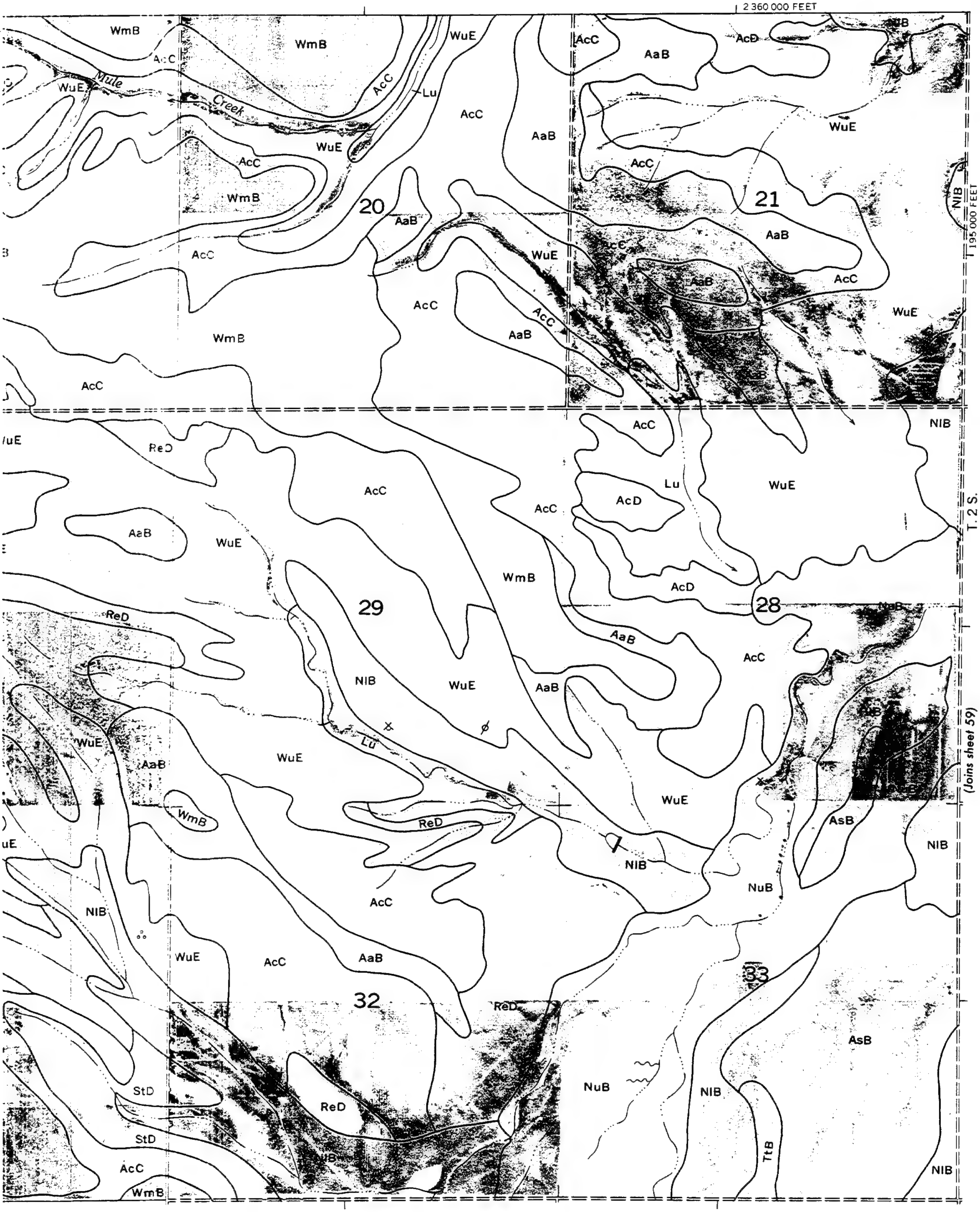

56
N
(Joins sheet 40)
R. 63 W.
(Joins sheet 55)
(Joins sheet 72)
2 295 000 FEET
185 000 FEET
Scale 1:20 000
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
20
21
22
27
28
29
32
33
34
Central Valley School
WmB
AsD
AsC
AcD
AcC
AsB
StD
Lu
VnD
AaB
int

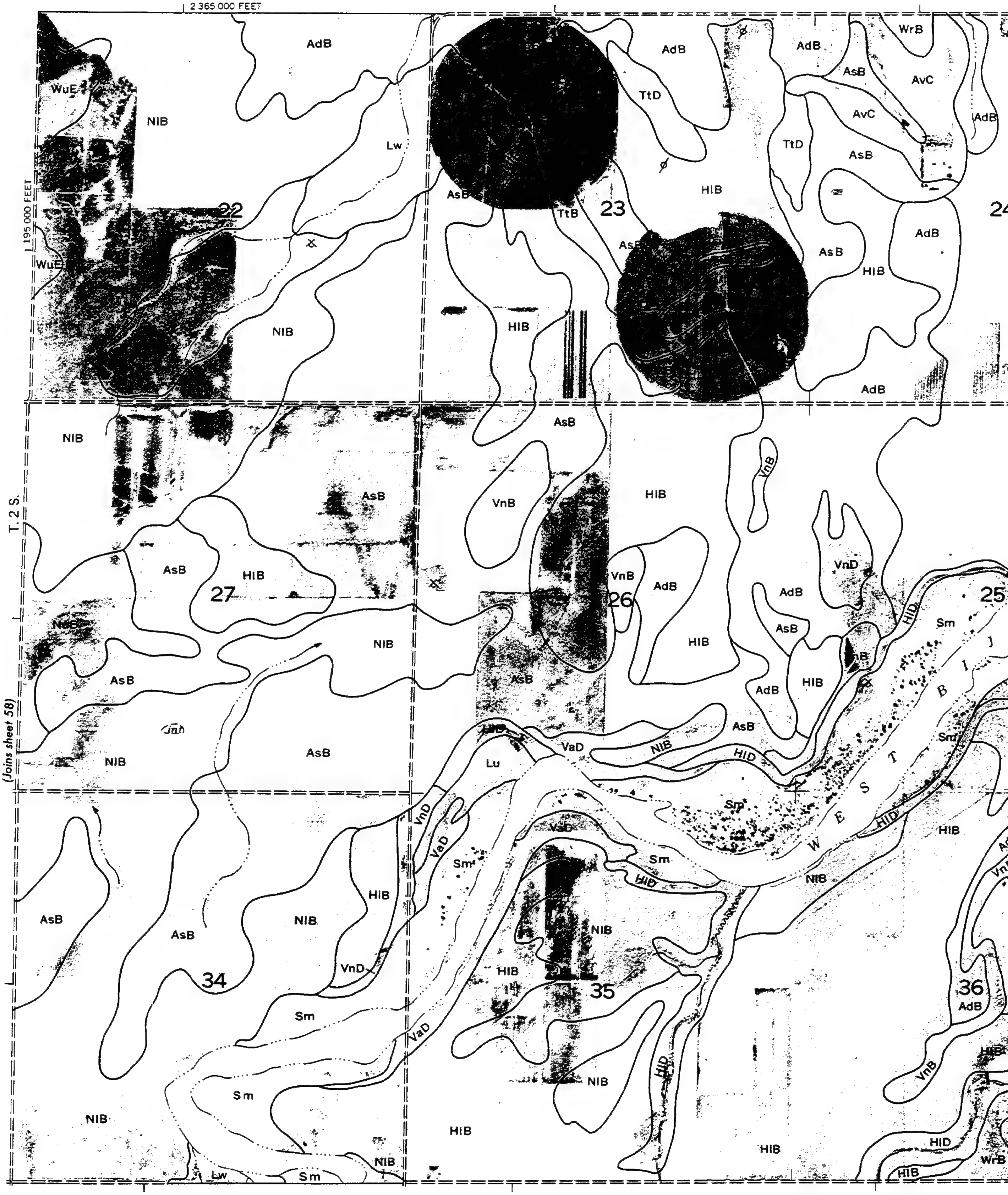

R. 63 W.
2 315 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 57)
AcC
WmB
AaB
AsD
StB
AsB
CbE
TsE
KIOWA CREEK
Sm
VaD
Lw
VnD
BoB
AsC
79
23
24
25
26
35
36

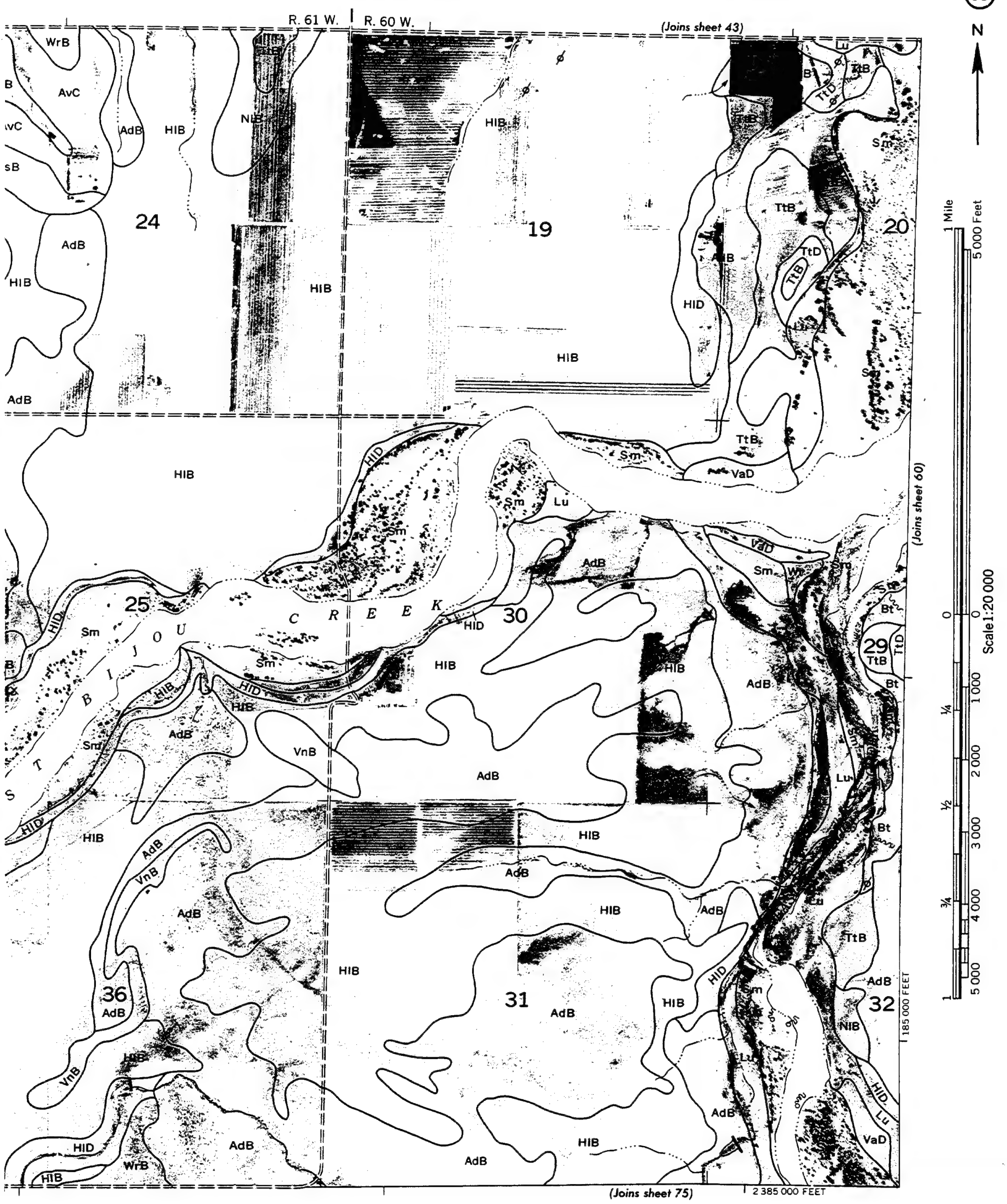

2 320 000 FEET
R. 62 W.
195 000 FEET
T. 2 S.
(Joins sheet 56)
19
20
21
28
29
30
31
32
33
KIOWA
CREEK
WmB
AcC
CbE
AaB
Lw
Sm
VaD
VnD
NIB
Lu
VnB
BoD
Bt
AsC
Tc
int
VsD
AsB
ArC
TtD
StD


R. 62 W.
(Joins sheet 41)
(Joins sheet 58)
(Joins sheet 73)
N
1 Mile
5 000 Feet
Scale 1:20 000
2 335 000 FEET
185 000 FEET
21
22
23
26
27
28
33
34
35
Wolf Creek
Comanche
VaD
VnD
VnB
Lw
AsB
WmB
AcC
Lw
VoB
VnD
AaB
NlB
Sm
AvC
AsC
int
AsD
StD
CbE
TtD
Lu
DaB
CbE


N
(Joins sheet 42)
R. 62 W.
R. 61 W.
(Joins sheet 57)
(Joins sheet 74)
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1 000
¼
2 000
½
3 000
4 000
¾
5 000
1
185 000 FEET
2 340 000 FEET
23
24
19
26
25
30
35
36
31
Mule
VoB
Lu
AcC
WuE
NlB
WmB
AaB
StD
CbE
ReD
ShF
TeD
AsD
AcD
Wm

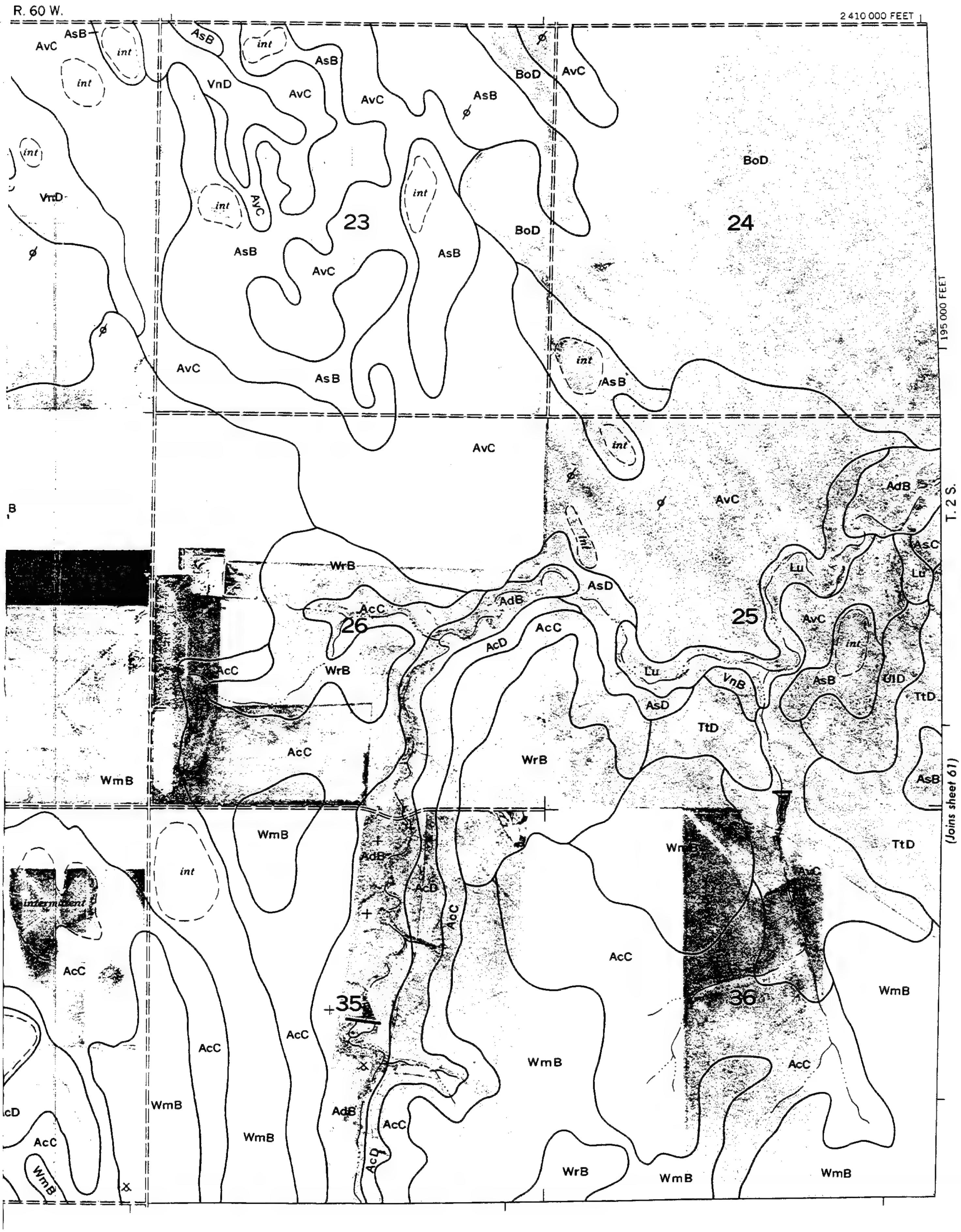

2 360 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 59)
Mule Creek
20
21
28
29
32
33
WmB
AcC
WuE
Lu
AaB
AcD
NIB
ReD
AsB
NuB
StD
TtB

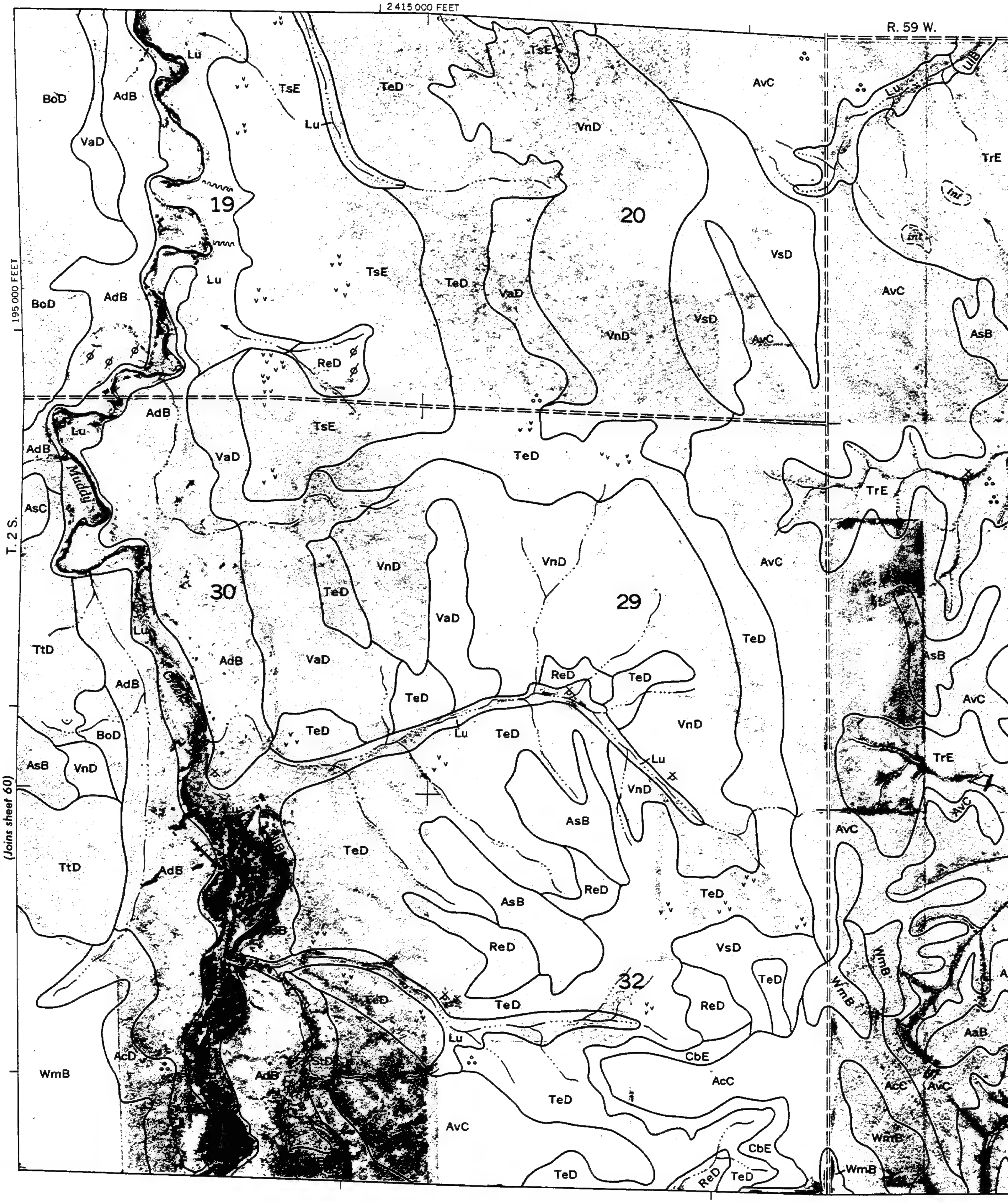

2 365 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 58)
22
23
24
25
26
27
34
35
36
WEST BIJOU
AdB
AsB
AvC
WrB
WuE
NlB
Lw
TtD
TtB
HlB
VnB
VnD
HlD
Sm
Lu
VaD
NsB

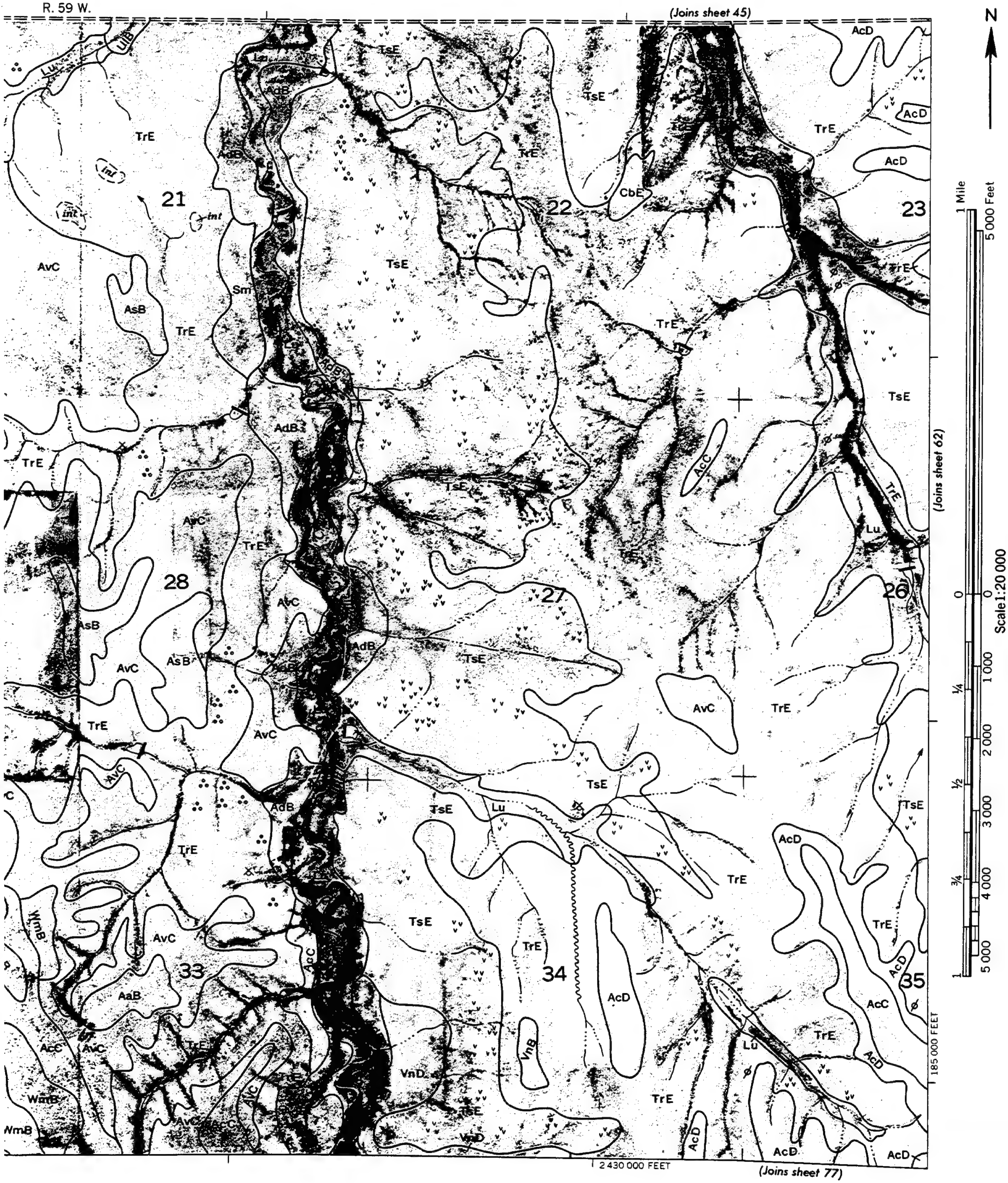


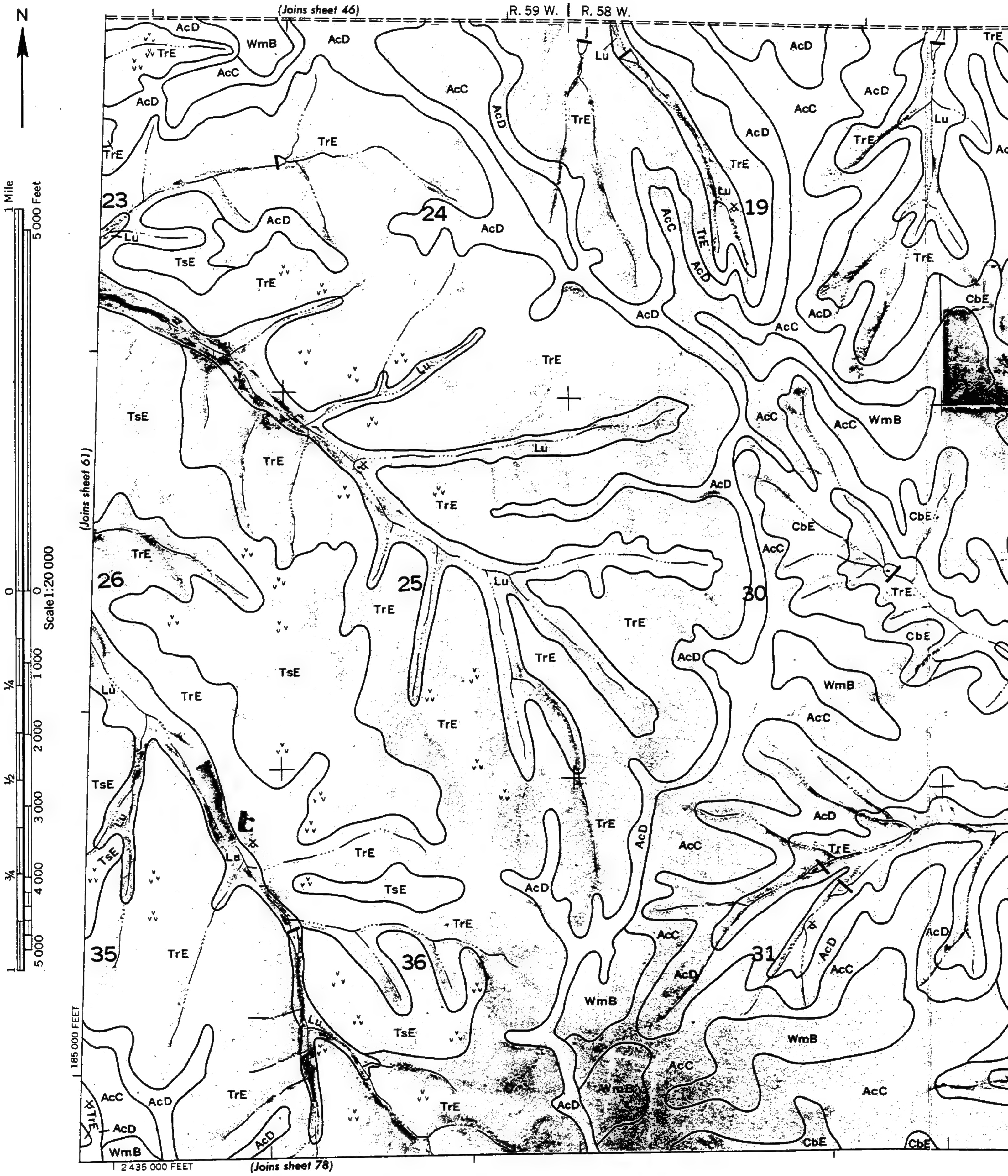
N
R. 61 W.
R. 60 W.
(Joins sheet 43)
(Joins sheet 60)
(Joins sheet 75)
2 385 000 FEET
185 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1000
2000
3000
4000
5000
24
19
20
25
30
29
36
31
32
BIJOU CREEK
WrB
AvC
AdB
HIB
NIB
HID
TtB
TtD
Sm
Lu
VaD
VnB
Bt
We

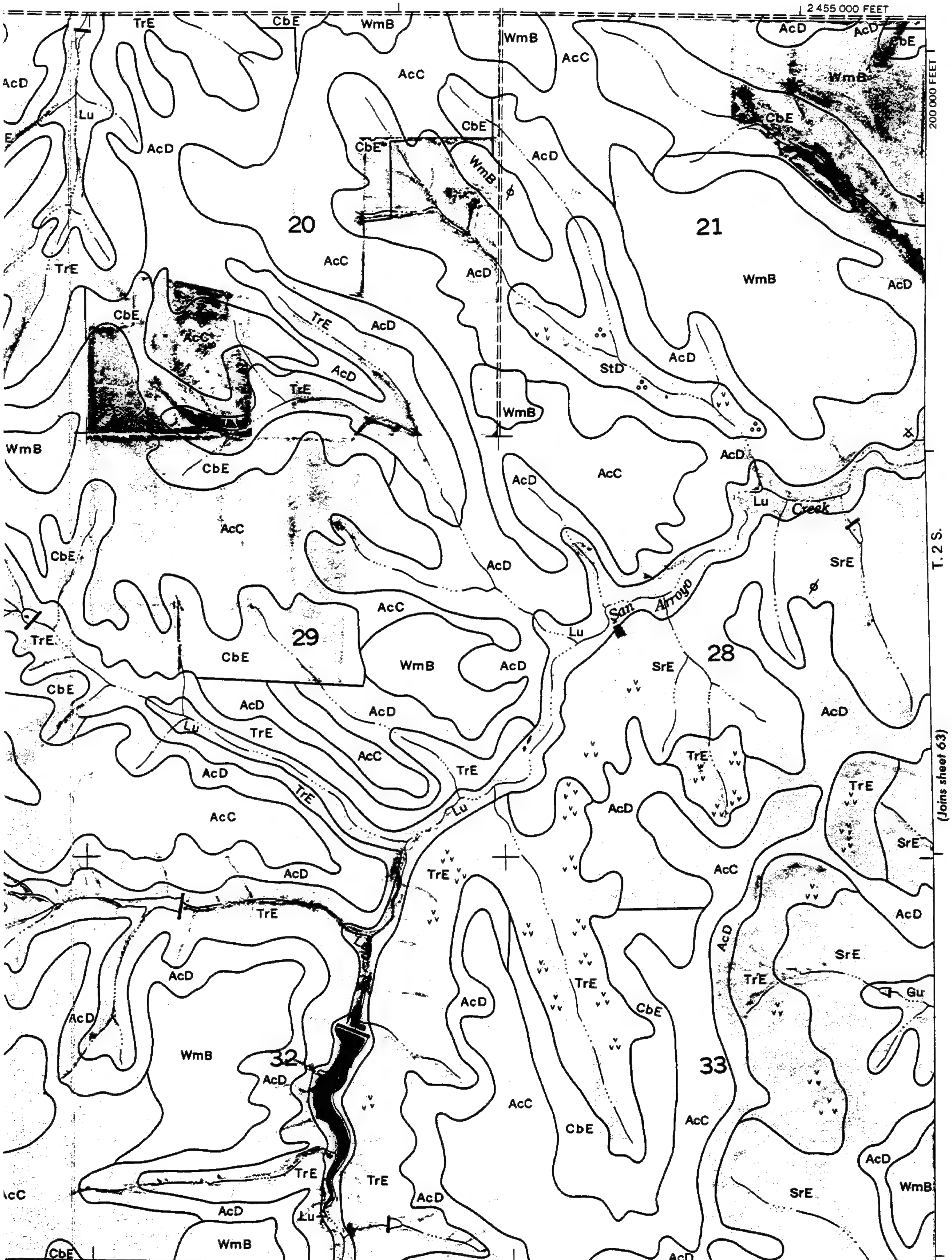

N
(Joins sheet 44)
R. 60 W.
(Joins sheet 59)
(Joins sheet 76)
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
185 000 FEET
2 390 000 FEET
BIJOU CREEK
20
21
22
27
28
29
32
33
34
TtD
Sm
TtB
Bt
AsB
WmB
AvC
VnD
AsB
int
intermittent
AcC
AcD
AdB
HlB
HlD
Lu

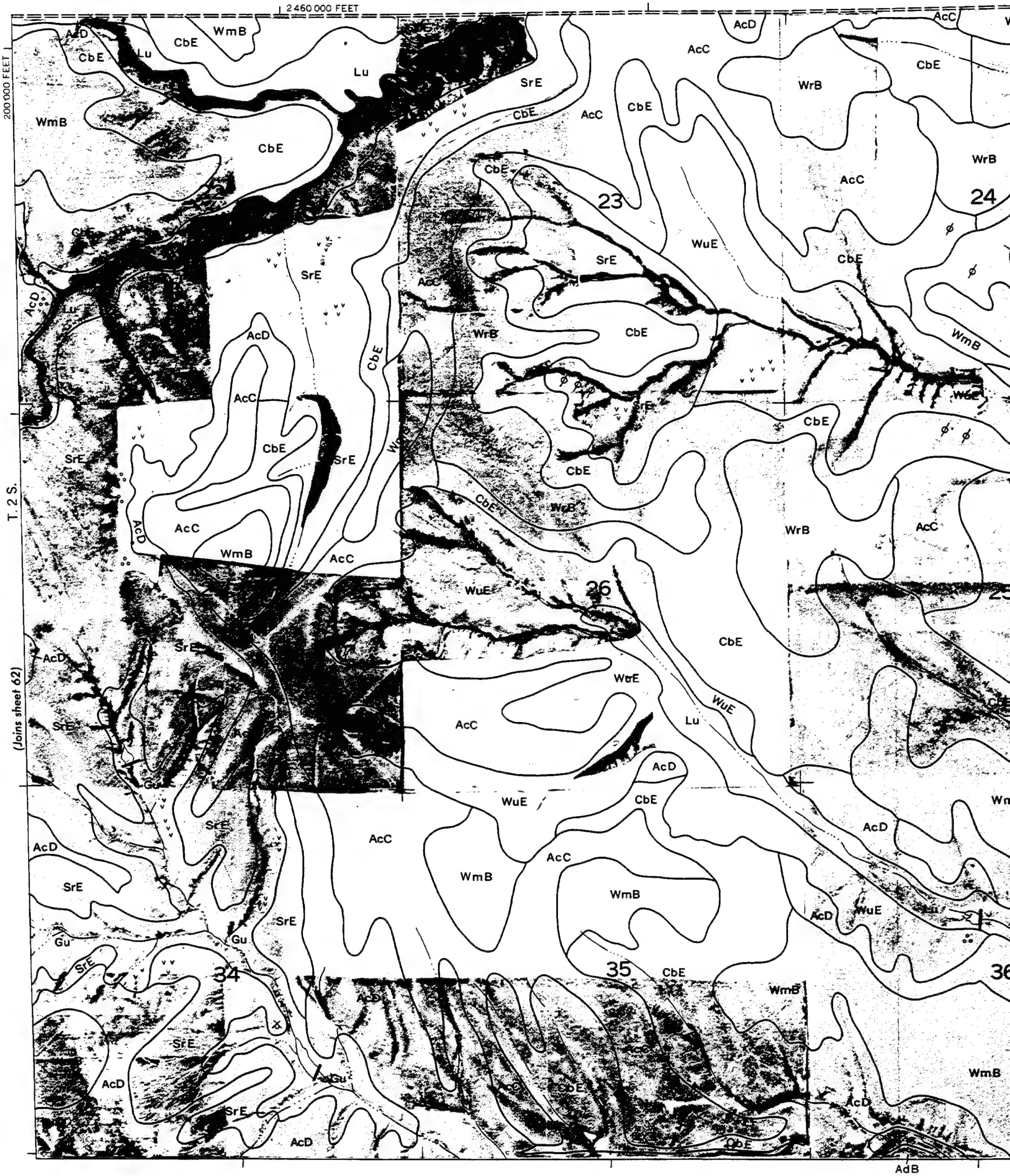

R. 60 W.
2 410 000 FEET
195 000 FEET
T. 2 S.
(Joins sheet 61)
23
24
25
26
35
36
AvC
AsB
int
VnD
BoD
AdB
AsC
Lu
AsD
AcC
AcD
WrB
VnB
TtD
UlD
WmB
intermittent


2 415 000 FEET
R. 59 W.
195 000 FEET
T. 2 S.
(Joins sheet 60)
19
20
29
30
32
Muddy
Creek
BoD
AdB
VaD
Lu
TsE
TeD
VnD
AvC
VsD
TrE
AsB
ReD
AsC
TtD
AcD
WmB
StD
CbE
AcC
AaB
UlB

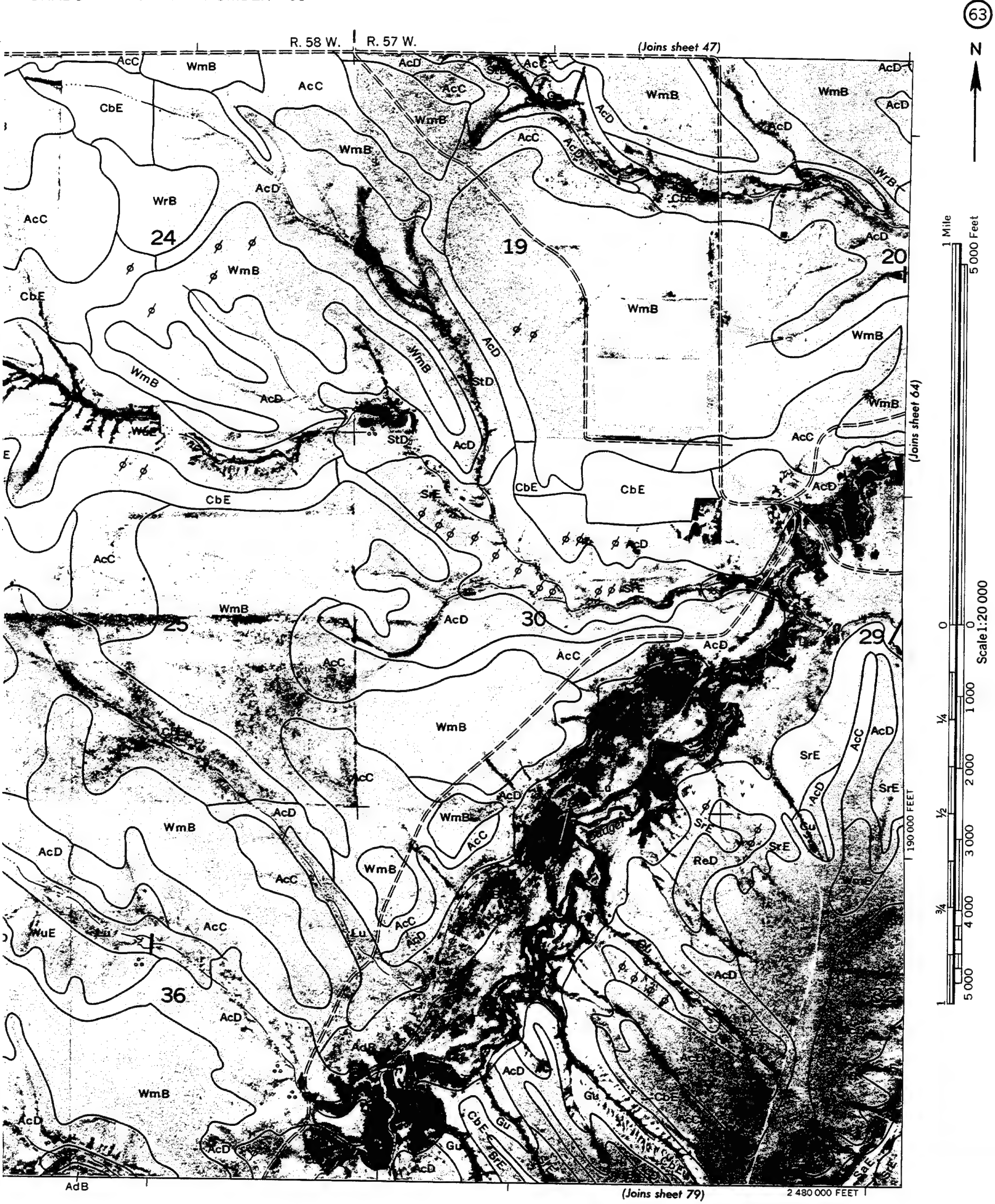

R. 59 W.
(Joins sheet 45)
(Joins sheet 62)
(Joins sheet 77)
N
21
22
23
26
27
28
33
34
35
TrE
TsE
AdB
AvC
AsB
AcD
AcC
CbE
Lu
Sm
AaB
WmB
VnB
VnD
int
2 430 000 FEET
185 000 FEET
Scale 1:20 000
1 Mile
0
1/4
1/2
3/4
1
5 000 Feet
0
1 000
2 000
3 000
4 000
5 000

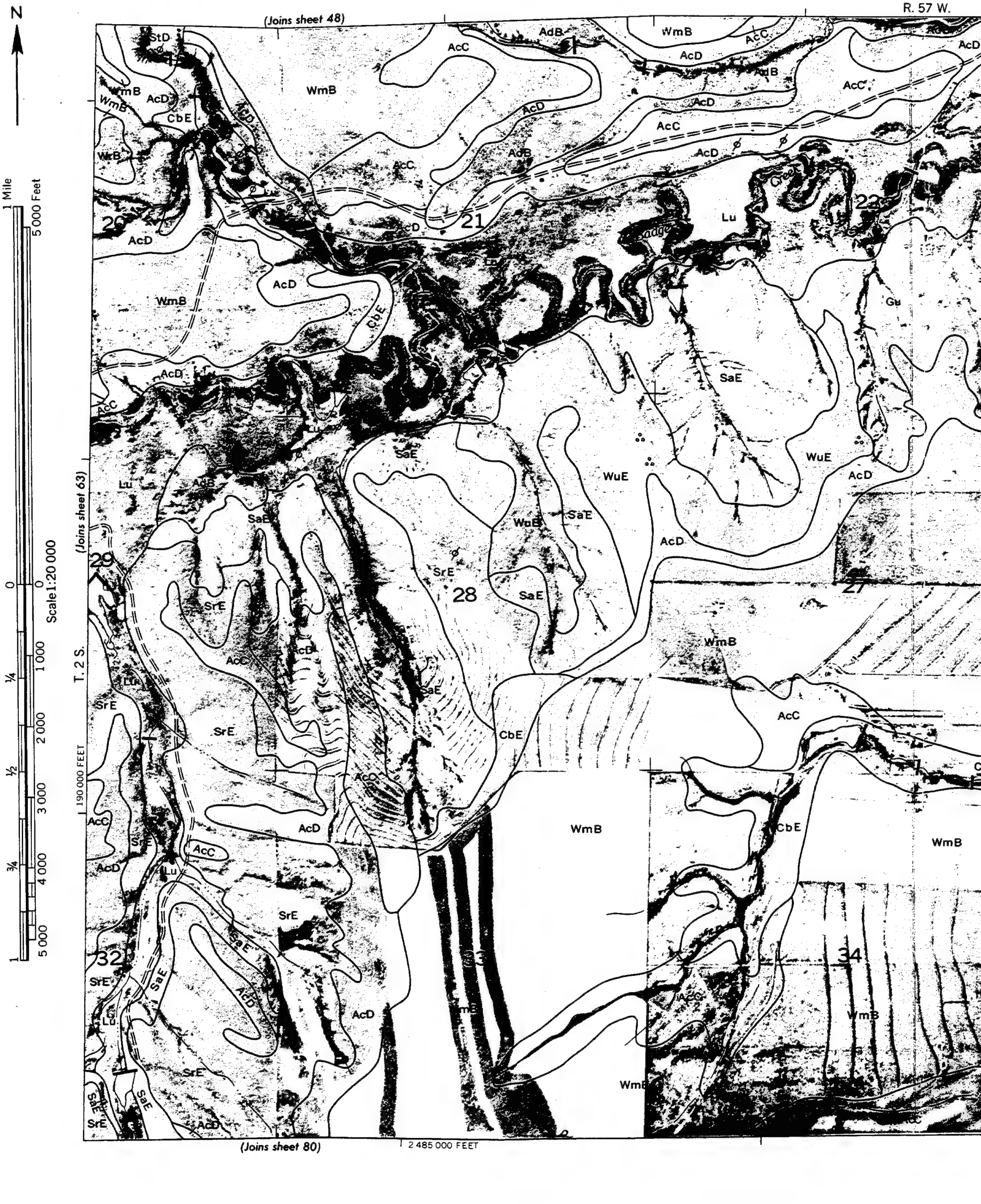

N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 46)
R. 59 W.
R. 58 W.
(Joins sheet 61)
(Joins sheet 78)
2 435 000 FEET
185 000 FEET
23
24
19
26
25
30
35
36
31
AcD
AcC
WmB
TrE
TsE
Lu
CbE

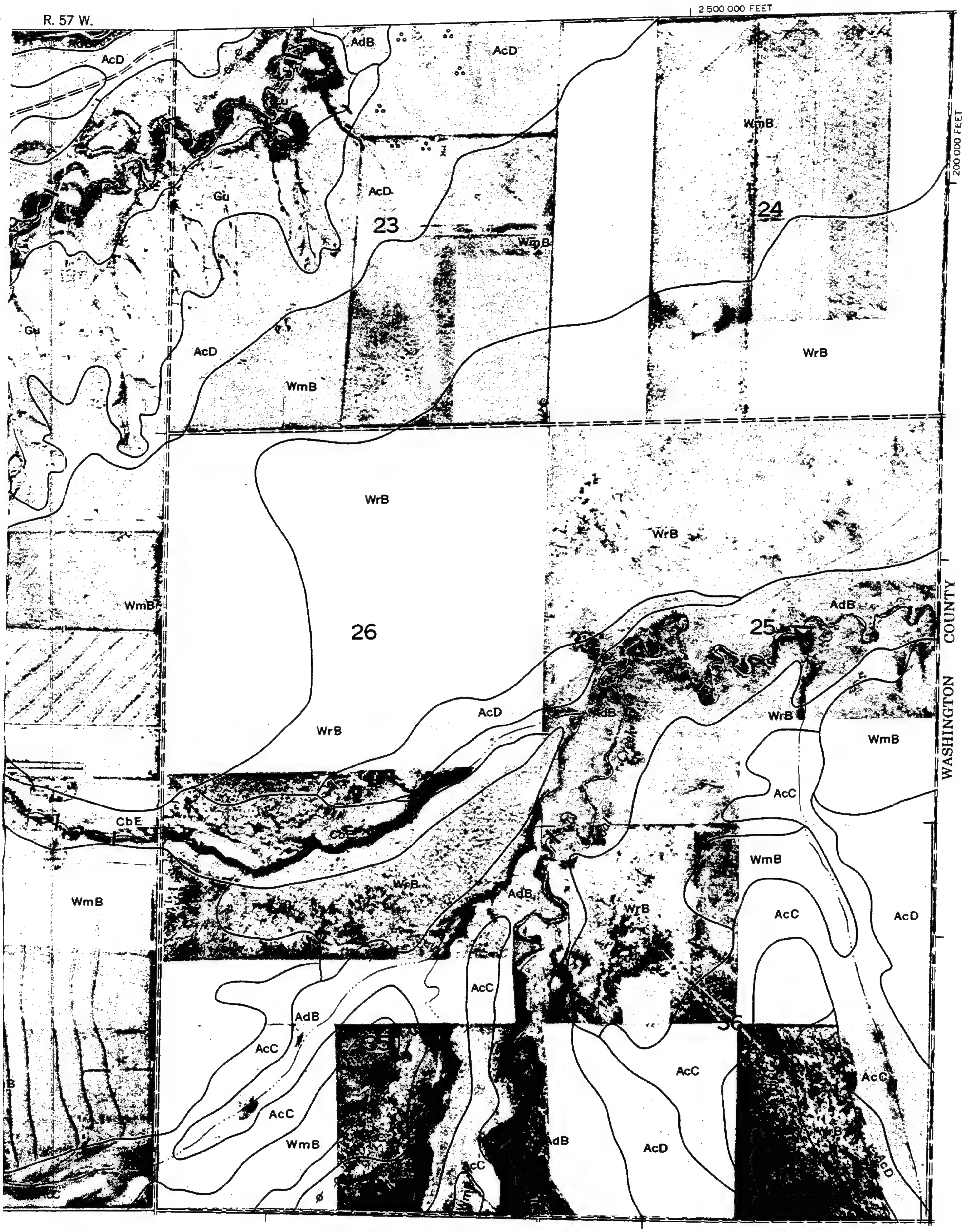

2 455 000 FEET
200 000 FEET
T. 2 S.
(Joins sheet 63)
San Arroyo
Creek
20
21
28
29
32
33
AcC
AcD
CbE
WmB
TrE
Lu
StD
SrE
Gu

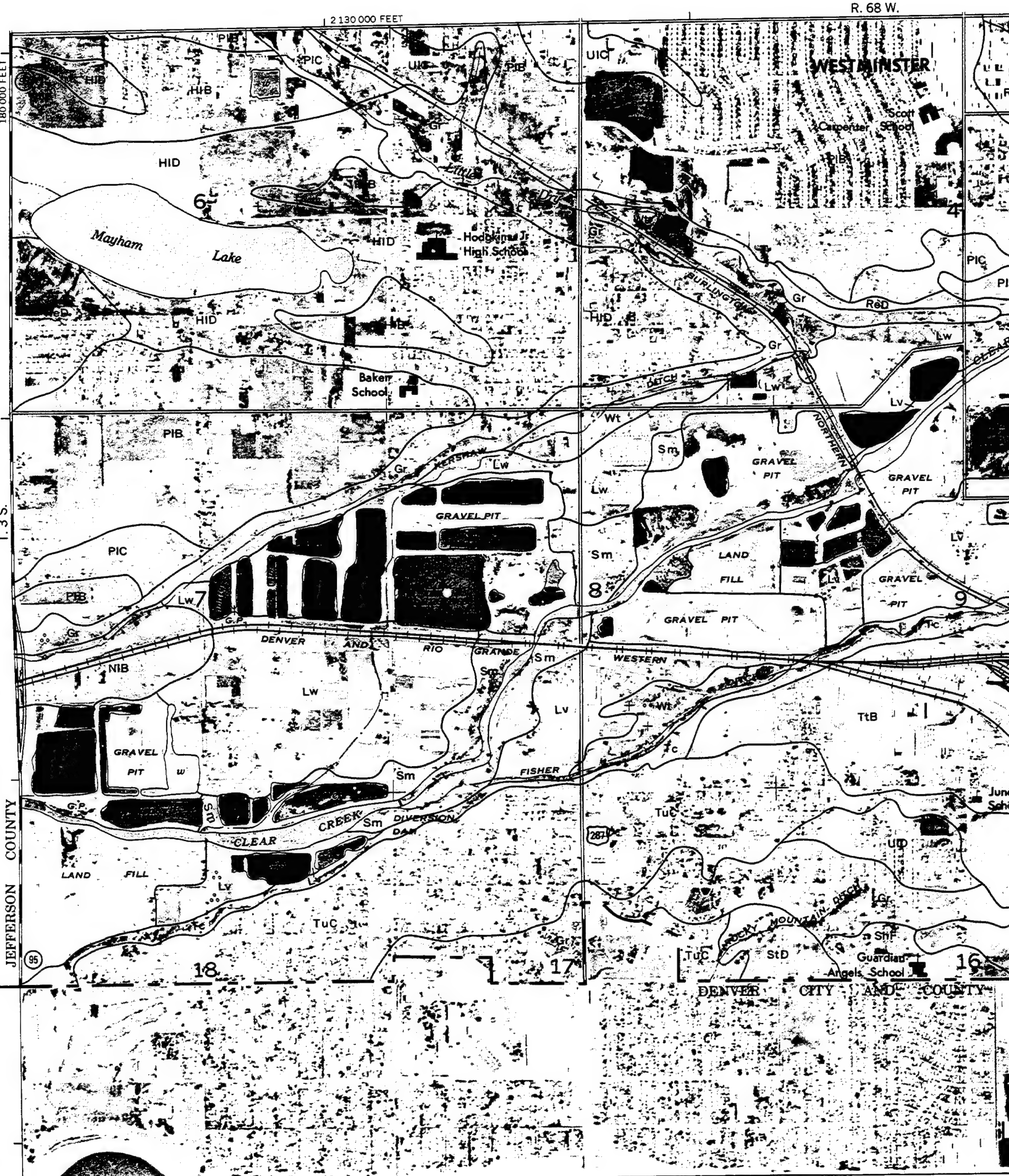

2 460 000 FEET
200 000 FEET
T. 2 S.
(Joins sheet 62)
AcD
CbE
WmB
Lu
SrE
AcC
WrB
23
24
26
34
35
36
WuE
Gu
AdB

COLORADO — SHEET NUMBER 63

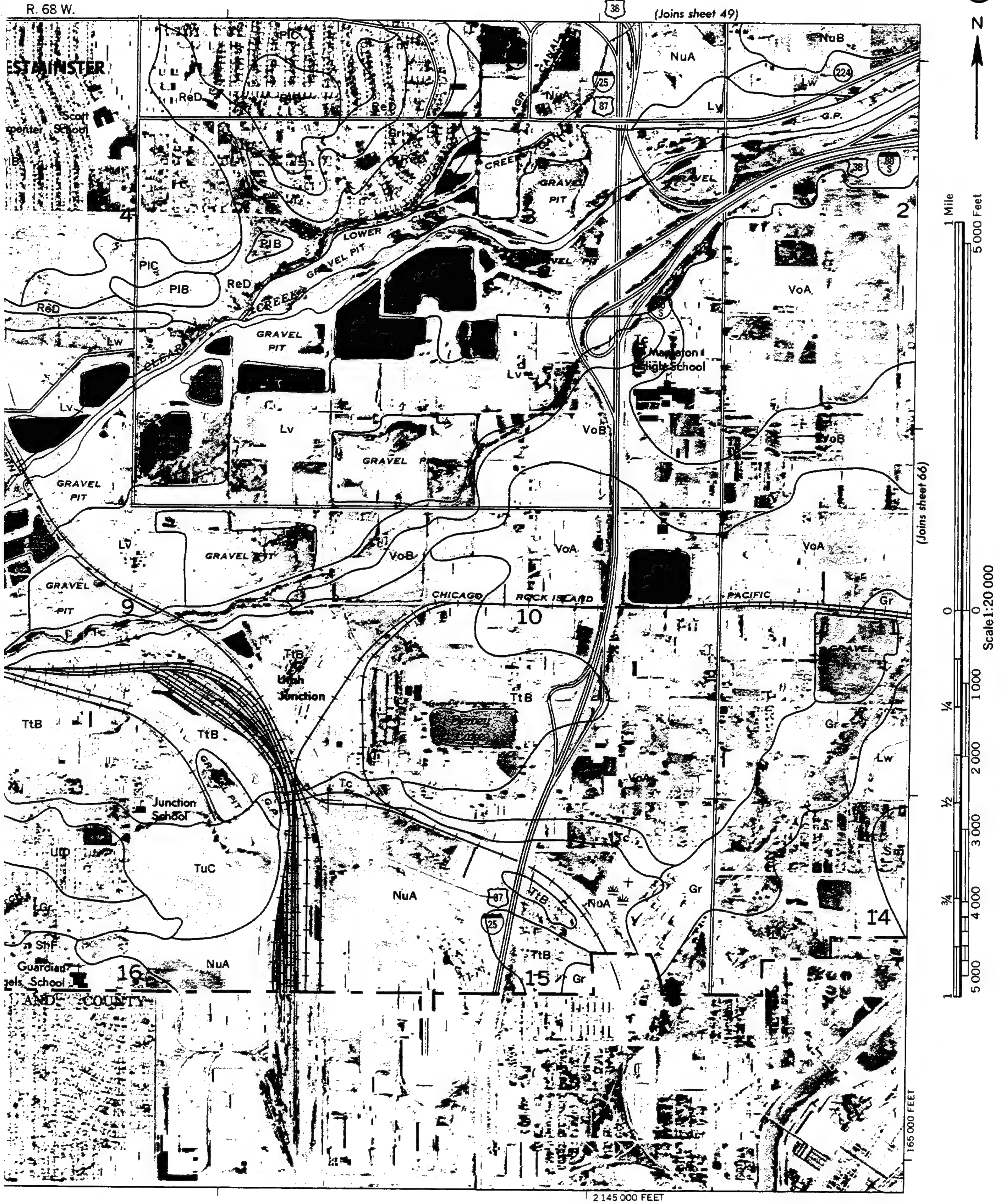


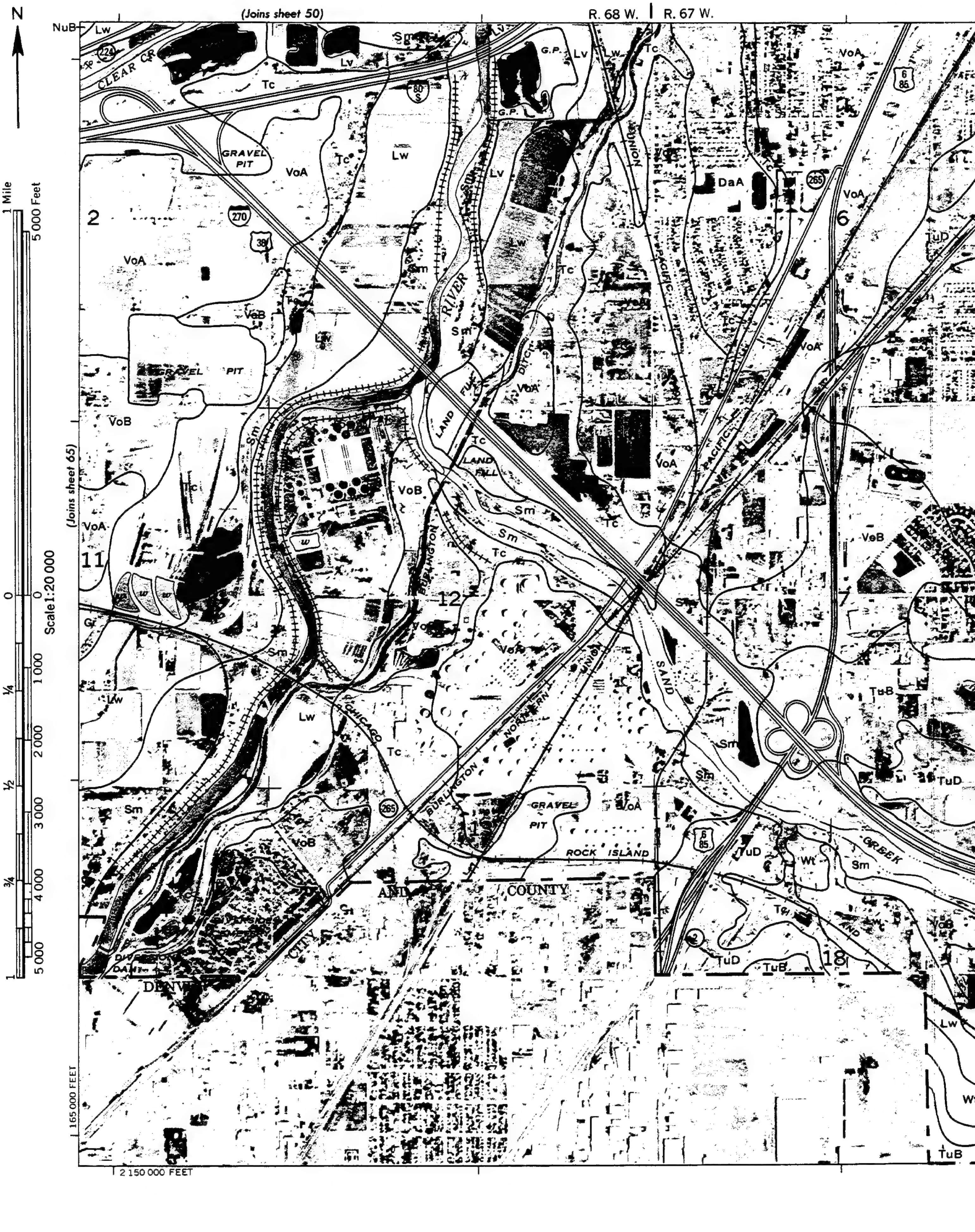

N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 48)
(Joins sheet 63)
(Joins sheet 80)
R. 57 W.
T. 2 S.
190 000 FEET
2 485 000 FEET
Badger Creek
20
21
22
27
28
29
32
33
34
StD
WmB
AcD
CbE
AcC
AdB
Lu
SaE
WuE
SrE
Gu
AcD
WmB
CbE
AcC
SaE
SrE

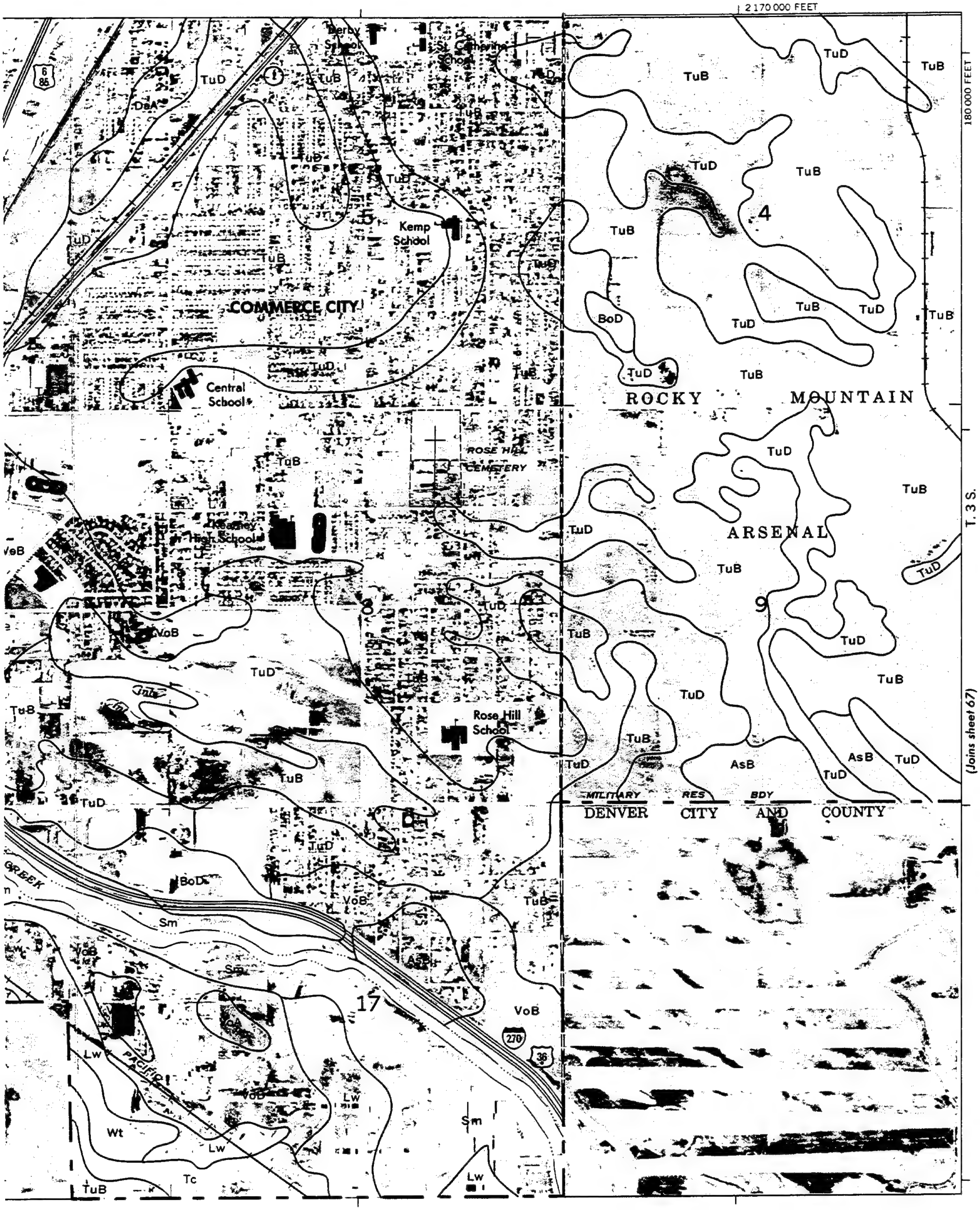

R. 57 W.
2 500 000 FEET
200 000 FEET
AdB
AcD
Gu
23
24
WmB
WrB
26
25
WASHINGTON COUNTY
CbE
AcC
35
36

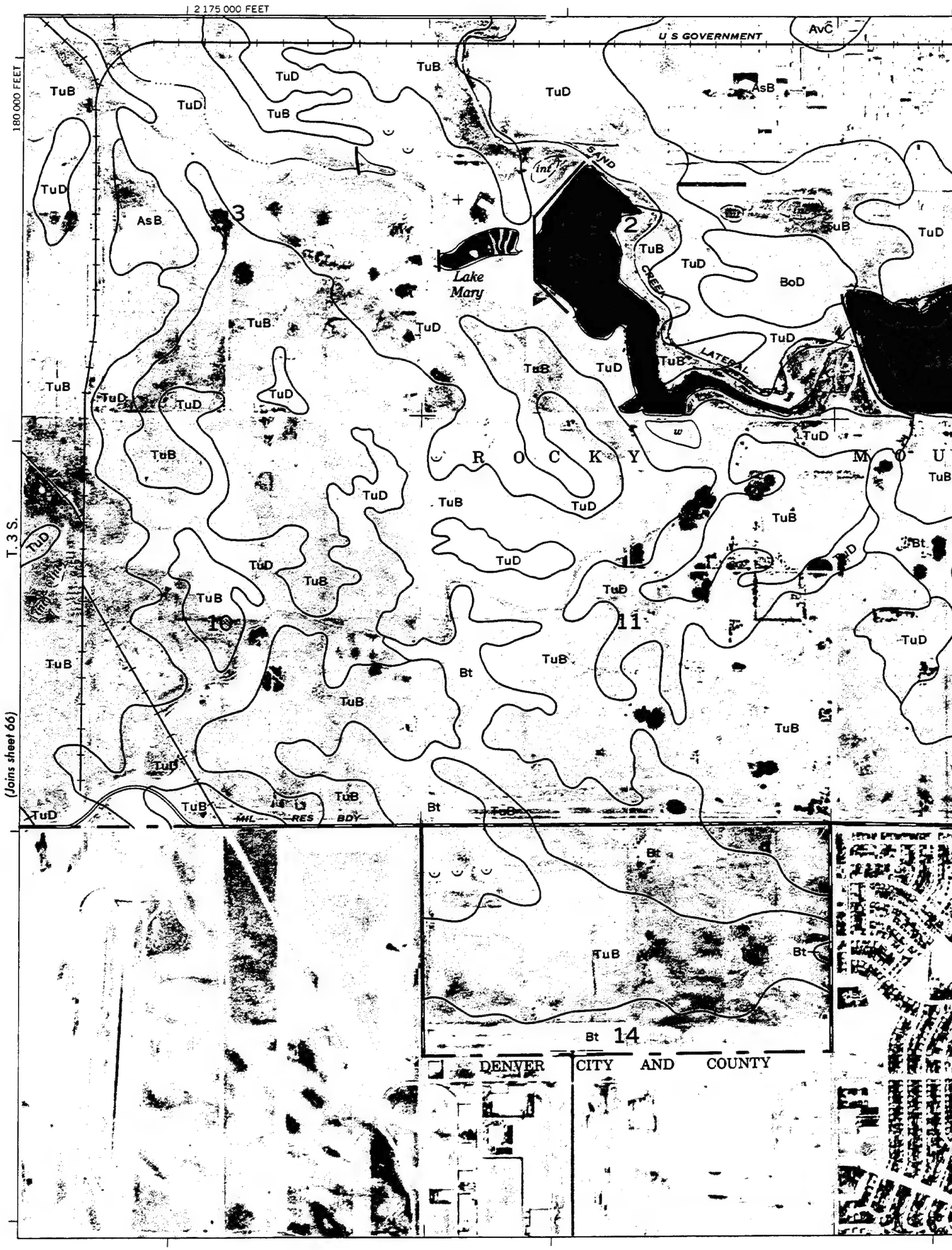


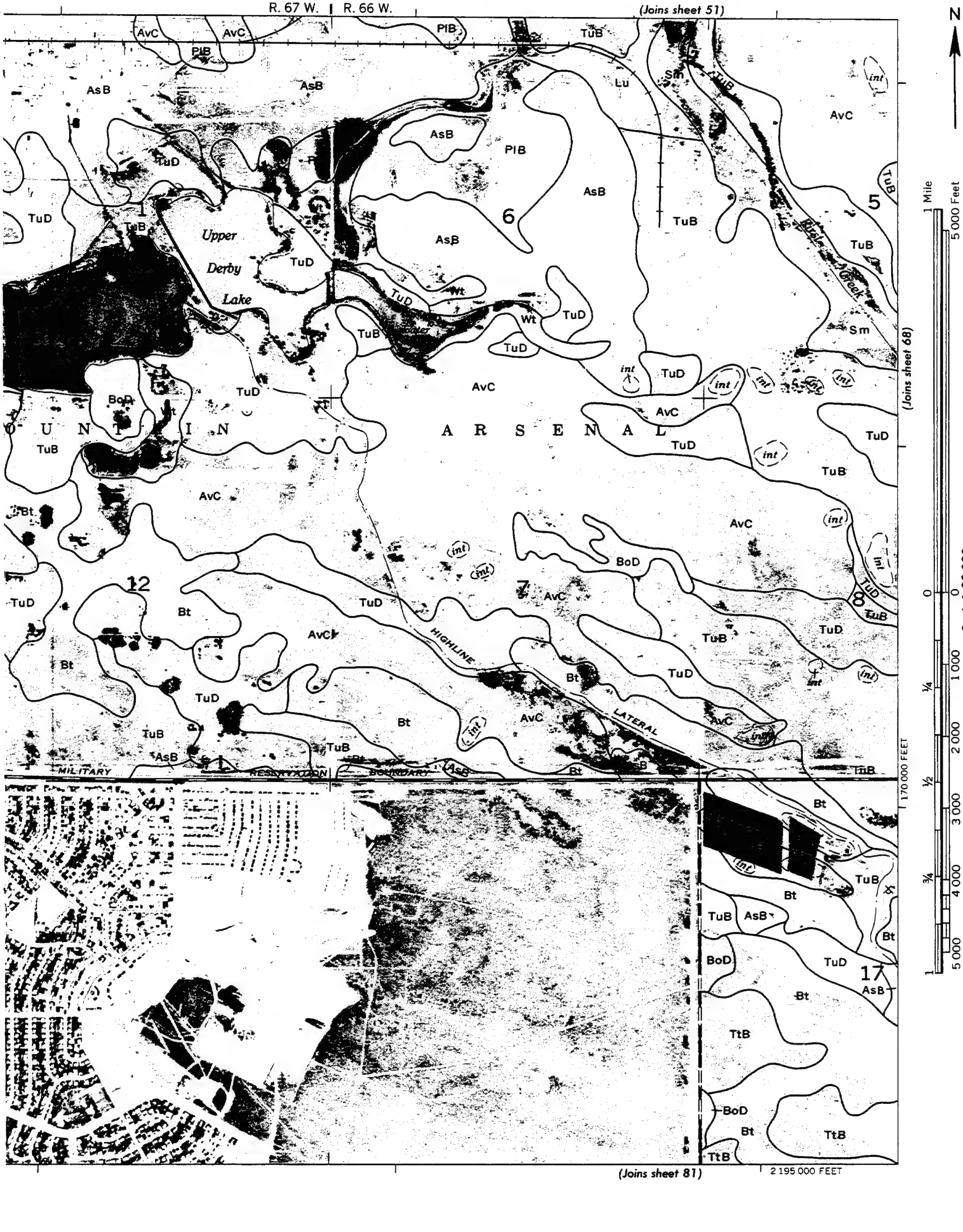
R. 68 W.
2 130 000 FEET
180 000 FEET
T. 3 S.
JEFFERSON COUNTY
WESTMINSTER
Scott Carpenter School
Hodgkins Jr High School
Baker School
Mayham Lake
Little Dry
BURLINGTON
NORTHERN
DITCH
KERSHAW
GRAVEL PIT
LAND FILL
DENVER AND RIO GRANDE WESTERN
FISHER
CLEAR CREEK
DIVERSION DAM
ROCKY MOUNTAIN DITCH
Guardian Angels School
DENVER CITY AND COUNTY
HID
HIB
PIB
PIC
UIC
Gr
ReD
Lw
Lv
Wt
Sm
NIB
G.P.
TtB
Tc
TuC
UID
StD
ShF
6
4
7
8
9
18
17
16
95
287

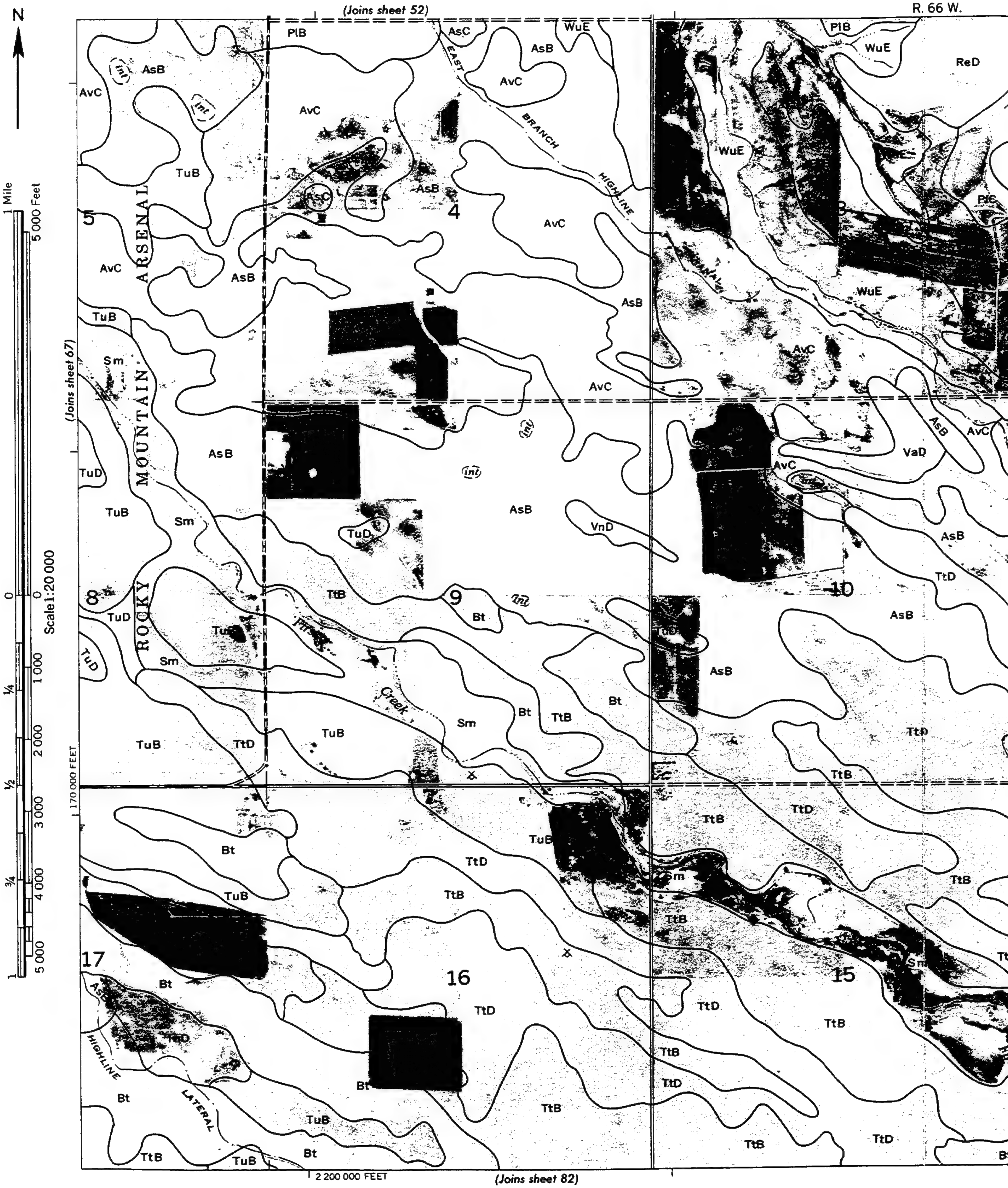

R. 68 W.
(Joins sheet 49)
(Joins sheet 66)
N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
165 000 FEET
2 145 000 FEET
ESTMINSTER
Junction School
Utah Junction
Mapleton High School
Guardian Angels School
LOWER CLEAR CREEK
GRAVEL PIT
CHICAGO ROCK ISLAND PACIFIC
NuA
NuB
Lv
Lw
ReD
PlB
PlC
VoA
VoB
Tc
TtB
TuC
Gr
Sm
ShF
Ud
4
3
2
9
10
11
14
15
16

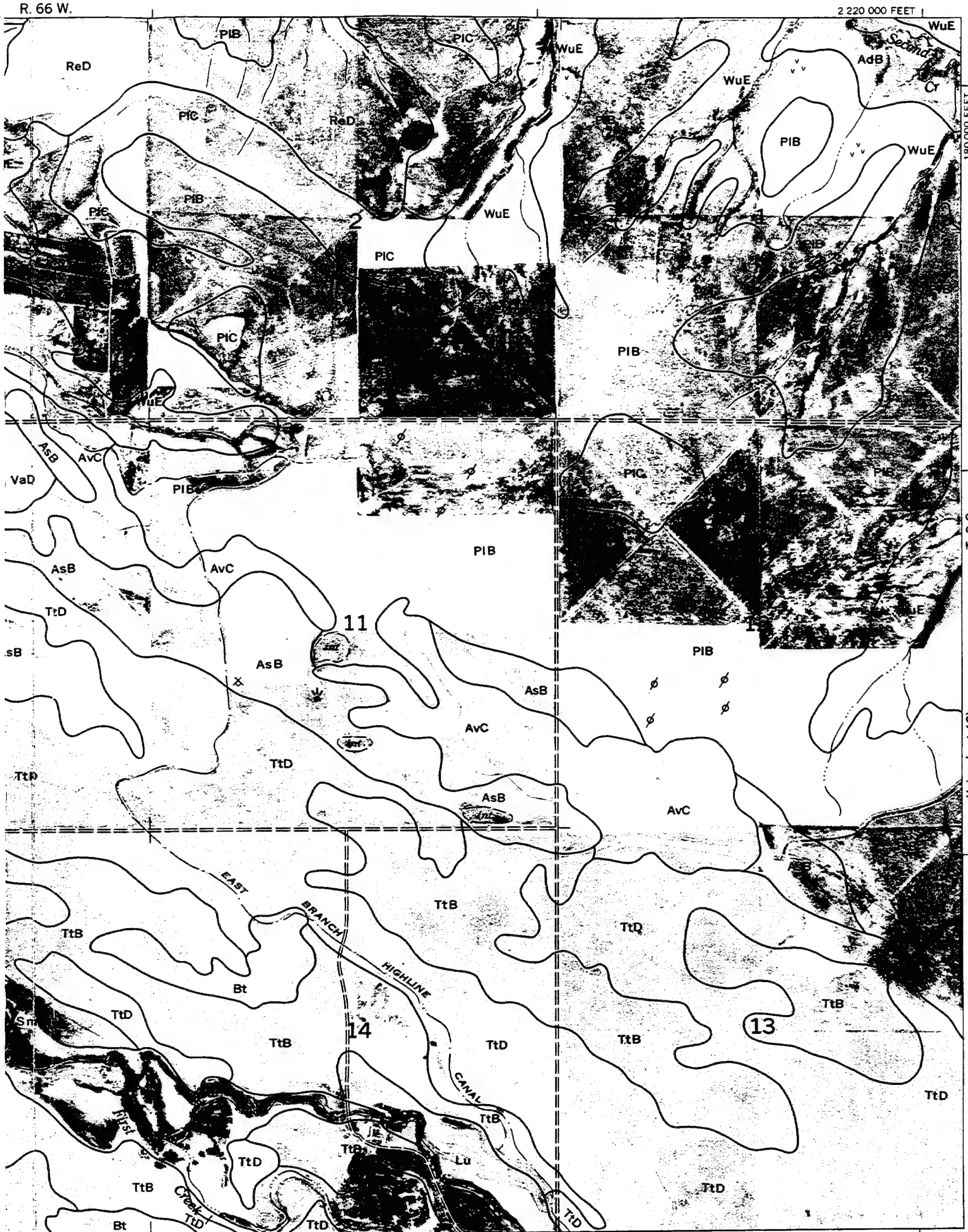

N
(Joins sheet 50)
R. 68 W.
R. 67 W.
(Joins sheet 65)
1 Mile
5 000 Feet
Scale 1:20 000
165 000 FEET
2 150 000 FEET
CLEAR CR
GRAVEL PIT
RIVER
LAND FILL
DITCH
UNION PACIFIC
BURLINGTON NORTHERN
CHICAGO
ROCK ISLAND
SAND CREEK
CITY AND COUNTY
DENVER
DIVERSION DAM
NuB
Lw
Lv
Tc
Sm
VoA
VoB
DaA
TuD
TuB
Wt
G.P.
2
6
7
11
12
18

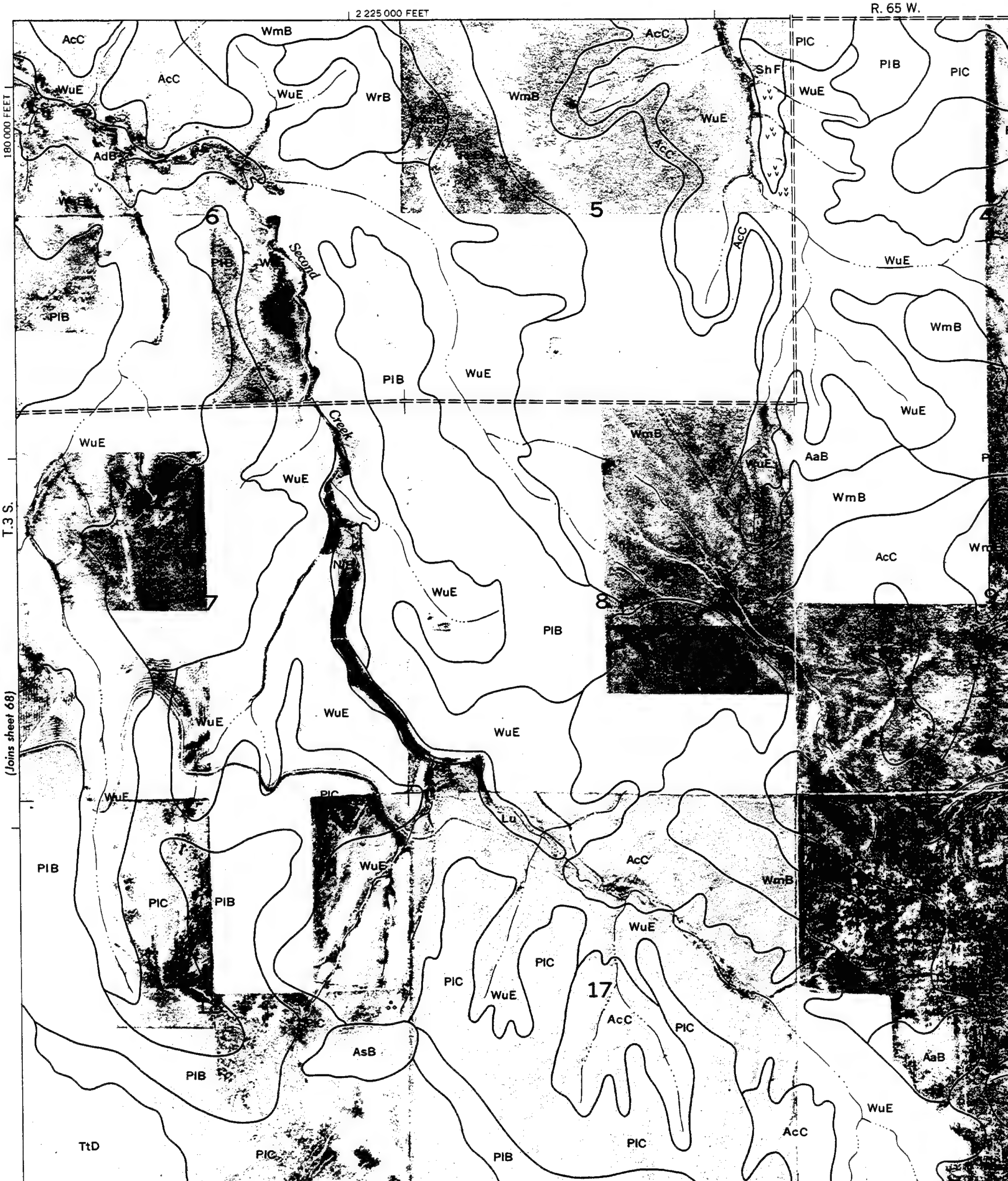

2 170 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 67)
COMMERCE CITY
Derby School
St. Catherine School
Kemp School
Central School
Kearney High School
Rose Hill School
ROSE HILL CEMETERY
ROCKY MOUNTAIN ARSENAL
MILITARY RES BDY
DENVER CITY AND COUNTY
4
5
8
9
17
TuB
TuD
BoD
DaA
VoB
AsB
Sm
Lw
Wt
Tc
CA
VeB
270
36

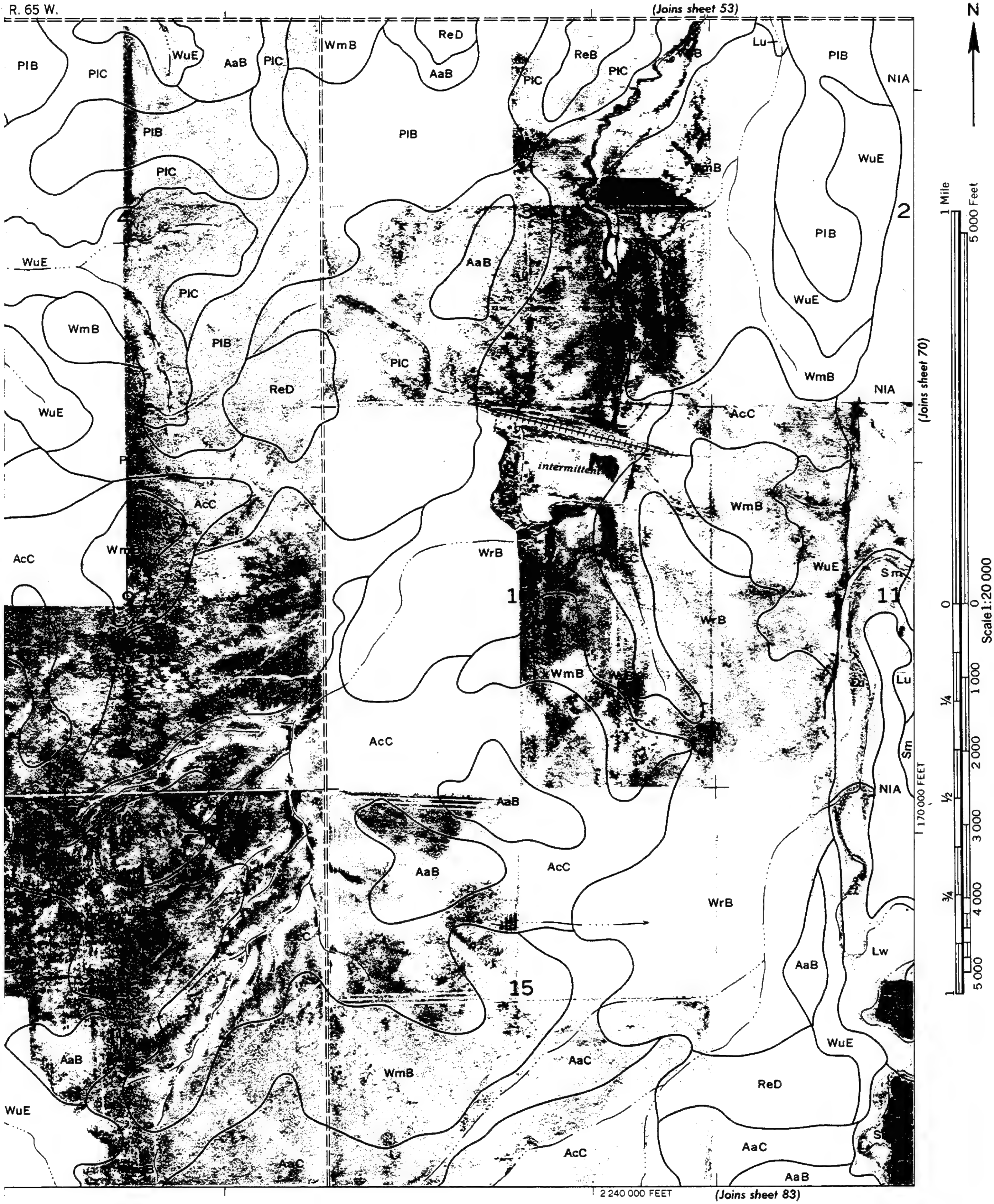

2 175 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 66)
U S GOVERNMENT
AvC
AsB
TuB
TuD
SAND
CREEK
LATERAL
int
Lake
Mary
BoD
w
R O C K Y
M O U
Bt
MIL RES BDY
2
3
10
11
14
DENVER
CITY
AND
COUNTY


R. 67 W.
R. 66 W.
(Joins sheet 51)
(Joins sheet 68)
(Joins sheet 81)
N
Upper
Derby
Lake
A R S E N A L
HIGHLINE
LATERAL
MILITARY
RESERVATION
BOUNDARY
AvC
PlB
AsB
TuB
TuD
Lu
Sm
Wt
BoD
Bt
TtB
int
5
6
7
8
12
17
170 000 FEET
2 195 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000


N
(Joins sheet 52)
R. 66 W.
(Joins sheet 67)
(Joins sheet 82)
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
170 000 FEET
2 200 000 FEET
ROCKY MOUNTAIN ARSENAL
EAST BRANCH HIGHLINE
HIGHLINE LATERAL
First Creek
5
4
8
9
10
15
16
17
AvC
AsB
AsC
PlB
WuE
ReD
TuB
TuD
Sm
VaD
VnD
Bt
TtB
TtD
int


R. 66 W.
2 220 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 69)
ReD
PlB
PlC
WuE
AdB
Second Cr
AsB
AvC
VaD
TtD
TtB
Bt
Sm
Lu
2
11
12
13
14
EAST BRANCH HIGHLINE CANAL
First Creek

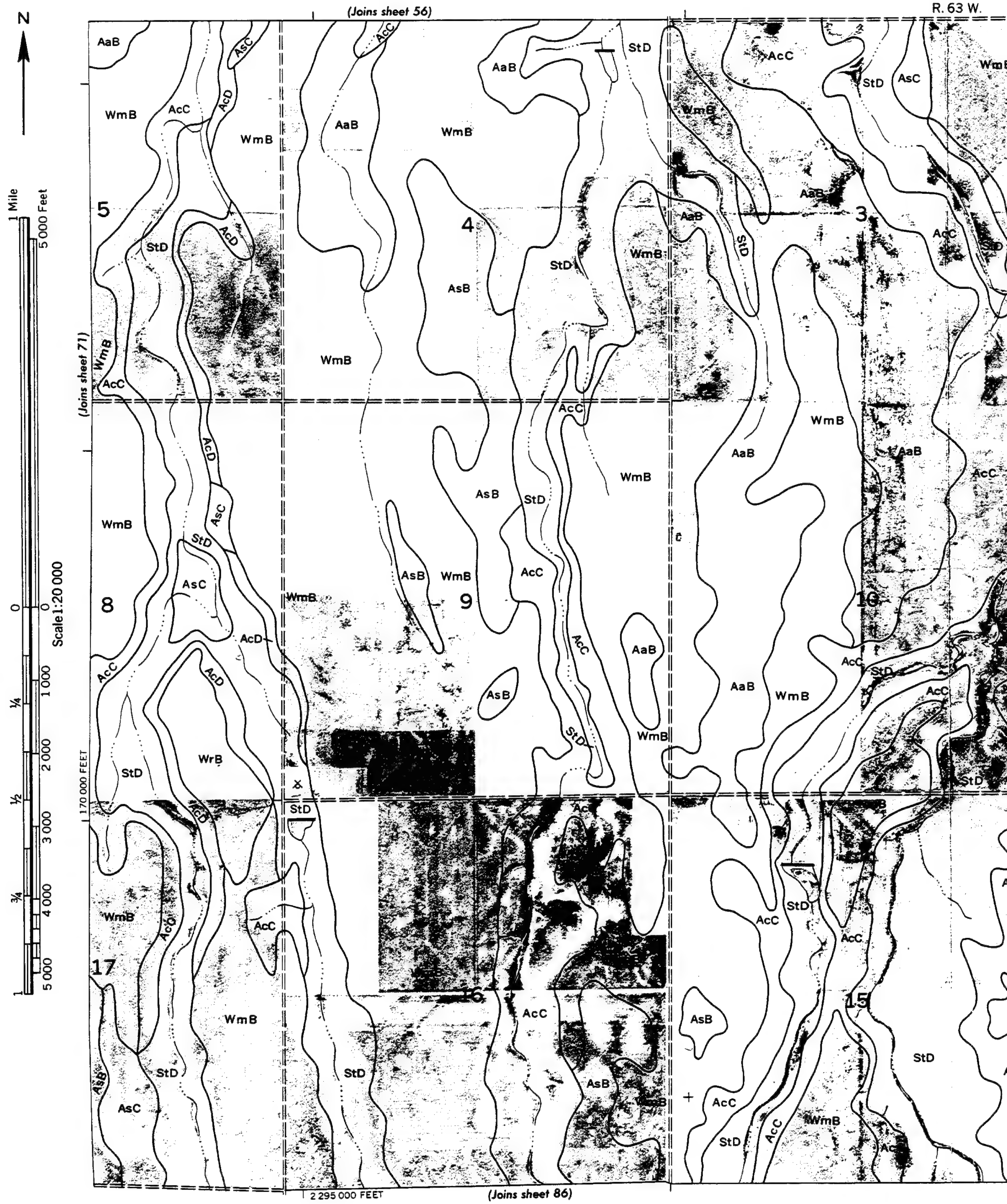

2 225 000 FEET
R. 65 W.
180 000 FEET
T. 3 S.
(Joins sheet 68)
Second
Creek
5
6
8
17
AcC
WmB
WuE
WrB
AdB
PIB
PIC
ShF
AaB
AcC
NE
Lu
AsB
TtD


R. 65 W.
(Joins sheet 53)
(Joins sheet 70)
(Joins sheet 83)
2 240 000 FEET
170 000 FEET
N
1 Mile
5 000 Feet
Scale 1:20 000
PlB
PlC
WuE
AaB
WmB
ReD
ReB
Lu
NlA
AcC
WrB
AaC
Sm
Lw
intermittent
2
1
11
15


2 265 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 71)
AsC
AsD
PlB
UlB
UlC
Lu
5
4
9
16
17
WmB
WuE
Bear
Gulch
AcC
AaB
AdB
AsB
WrB
ShF
UlC
UlB
AcC
AsC

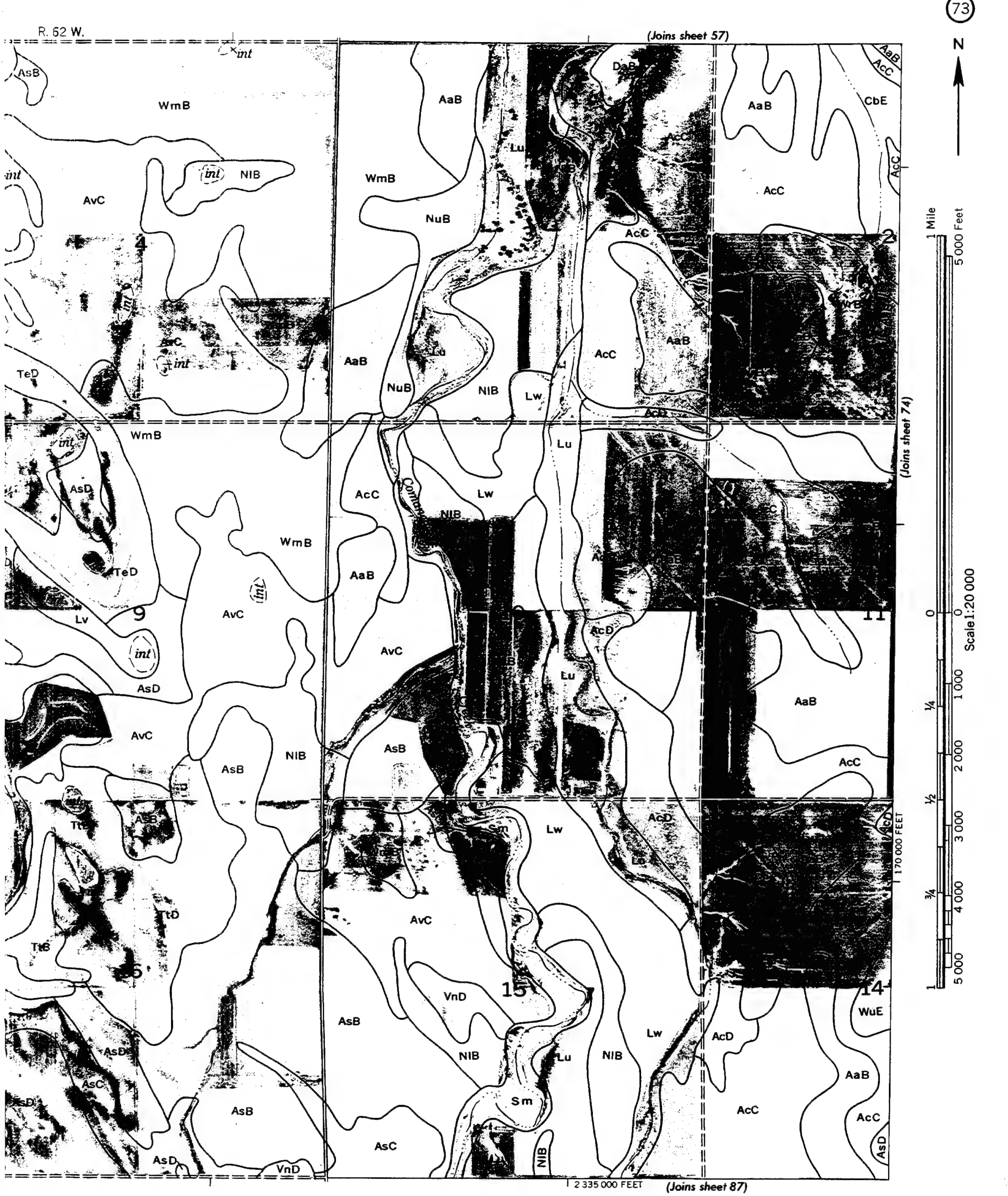

2 270 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 70)
3
2
1
10
11
12
15
14
WmB
WrB
AcC
AsC
AsB
StD
VnD
Lu
WuE
NlB
AaB
AaC
UlB
ArC
NuA
TeD
int

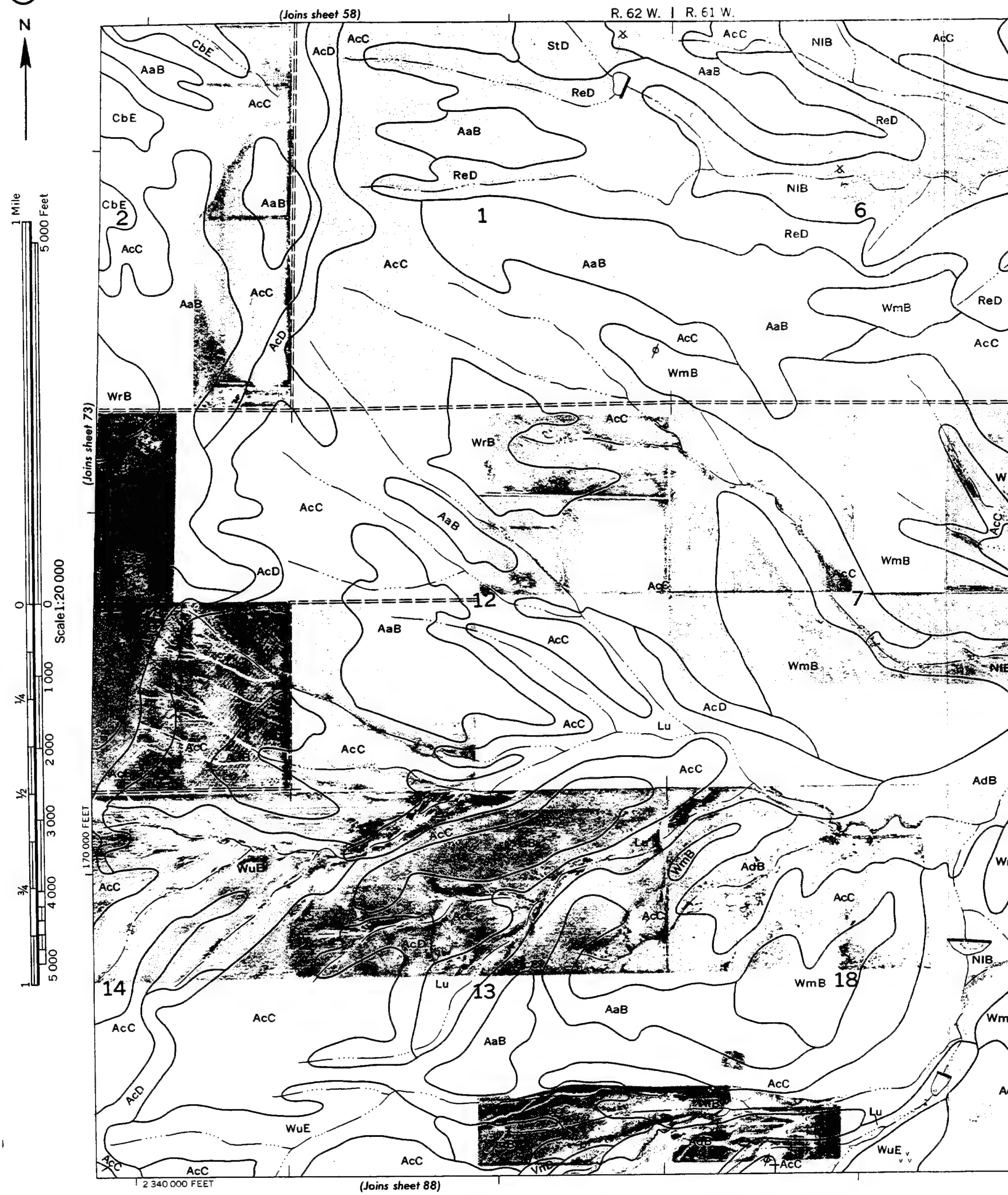

R. 64 W.
R. 63 W.
(Joins sheet 55)
(Joins sheet 72)
(Joins sheet 85)
N
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000
165 000 FEET
2 290 000 FEET
1
6
12
8
3
17
AvC
WmB
AcC
AaB
StD
AcC
Lu
VnD
WuE
NIB
AcC
WmB
AsB
AaB
WrB
Lu
WmB
StD
AsD
AaC
AcC
WuE
AaB
AsC
WmB
Creek
StD
WmB
StD
AaC
Lost
Lu
StD
WmB
AaC
AaB
StD
AsC
WmB
StD
AaC
WmB
AcC
StD
AsC
AsB
WuE
AaC
AaB
AsC
TeD
AcC
WmB
StD
WmB
AcC
AaB
AcC
StD
AsB
AcD
VnD
StD
AsC
AaC
AcC
WuE
AsC
VnD
AsB

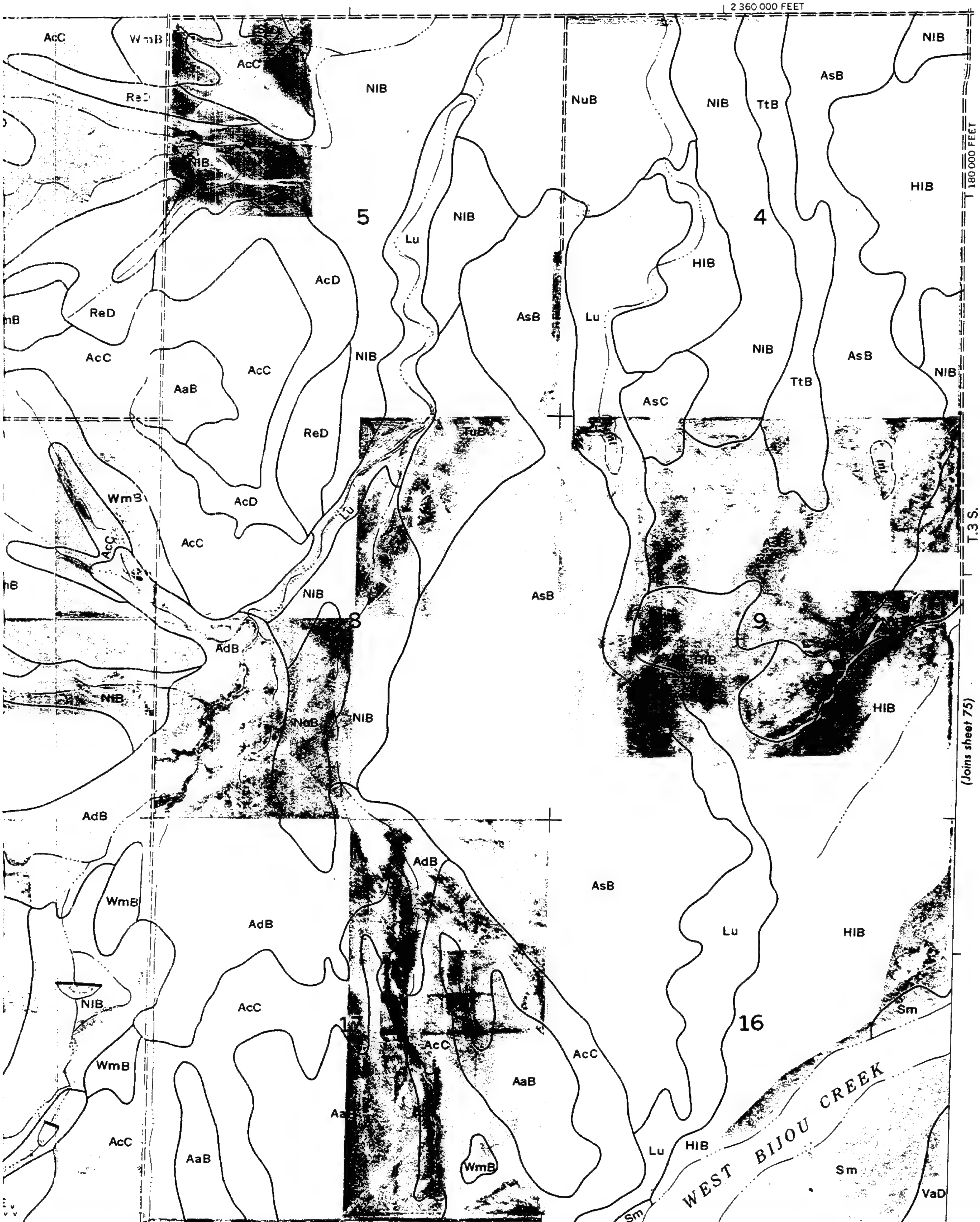

N
(Joins sheet 56)
R. 63 W.
(Joins sheet 71)
(Joins sheet 86)
2 295 000 FEET
170 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
AaB
AcC
AcD
AsB
AsC
StD
WmB
WrB
3
4
5
8
9
10
15
16
17


R. 63 W.
2 315 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 73)
KIOWA
CREEK
79
1
2
11
12
13
4
WmB
AsC
AaB
AcC
CbE
Lw
BoD
VnD
int
Sm
AvC
Tc
StD
AcD
AsD
TtD
AsB
Lv
StB
Bt


2 320 000 FEET
R. 62 W.
180 000 FEET
T. 3 S.
(Joins sheet 72)
6
7
8
9
18
Wolf Creek
Wolf Creek
AsB
AsC
VnD
AcC
AaB
AsD
ArC
AsB
WmB
AcC
NlB
AcD
AcC
AaB
TtD
AsB
TtD
AsB
AsD
AaB
AcC
AcC
AcC
int
int
int
AsC
AsD
AaB
WmB
AsB
AsC
AsB
AaB
TtD
WmB
AaB
Lu
Lu
NlB
VnD
AvC
VnD
AvC
TeD
AvC
WmB
TeD
AsD
VnD
AsB
AsD
TeD
Lv
AsD
AvC
VnD
NlB
TtB
TtD
AsB
AsC

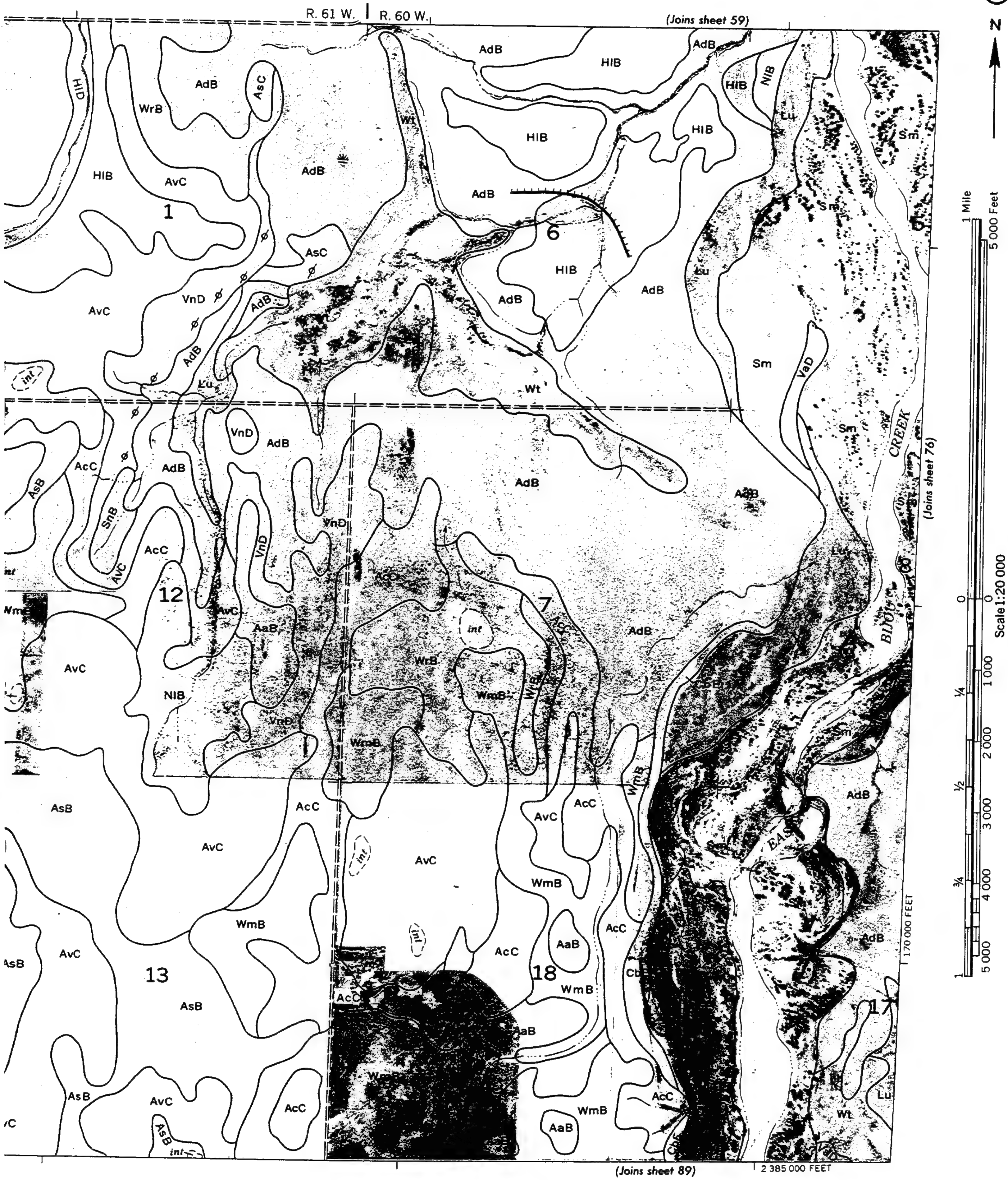

73
N
R. 62 W.
(Joins sheet 57)
(Joins sheet 74)
(Joins sheet 87)
2 335 000 FEET
170 000 FEET
AsB
WmB
int
NIB
AvC
AaB
NuB
AcC
CbE
DaB
Lu
Lw
AcD
TeD
AsD
Lv
AsB
AsC
TtB
TtD
VnD
Sm
WuE
4
9
2
11
15
14
Contour
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000


N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 58)
(Joins sheet 73)
(Joins sheet 88)
R. 62 W.
R. 61 W.
170 000 FEET
2 340 000 FEET
1
2
6
7
12
13
14
18
AaB
AcC
AcD
AdB
CbE
StD
NlB
ReD
WmB
WrB
WuE
Lu

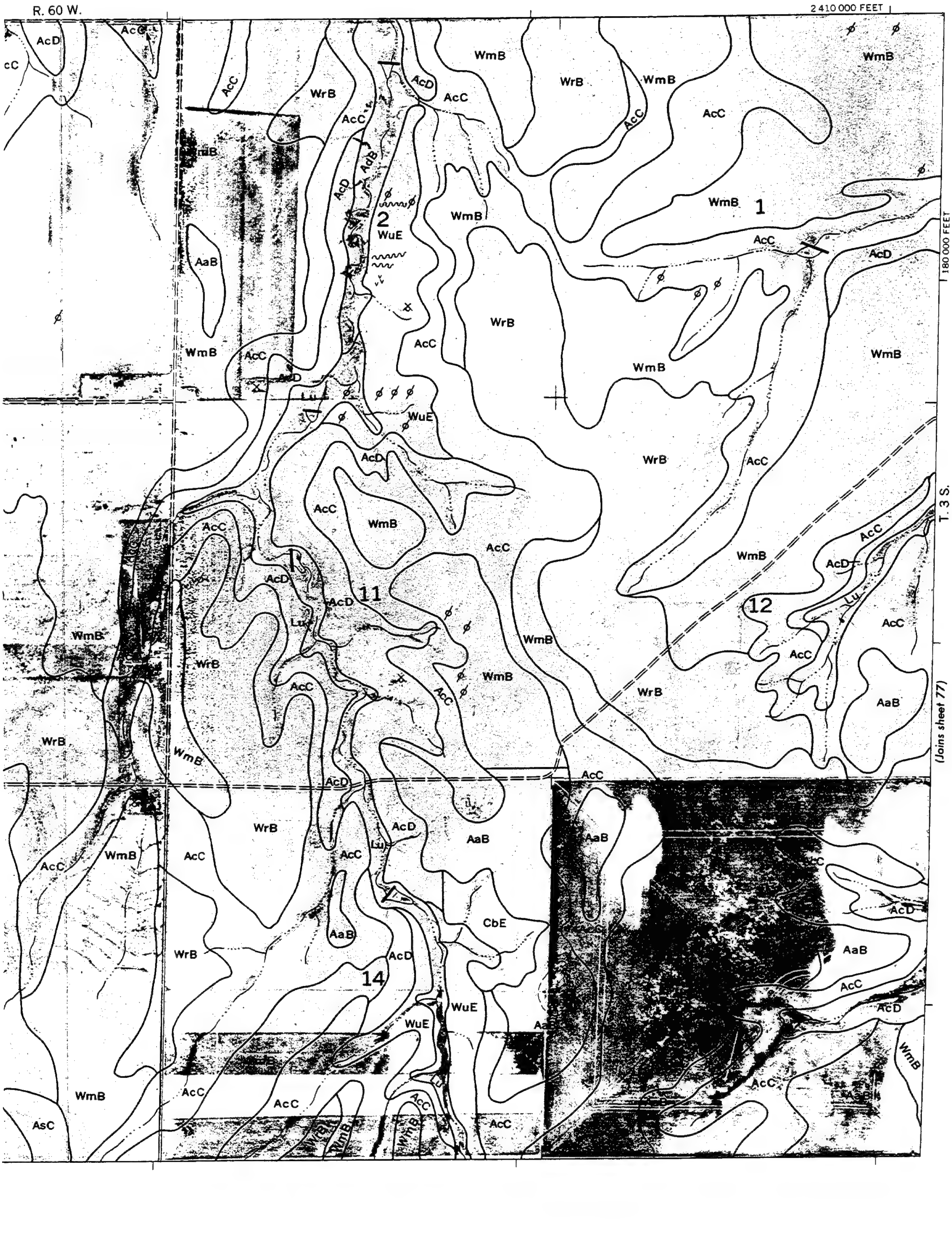


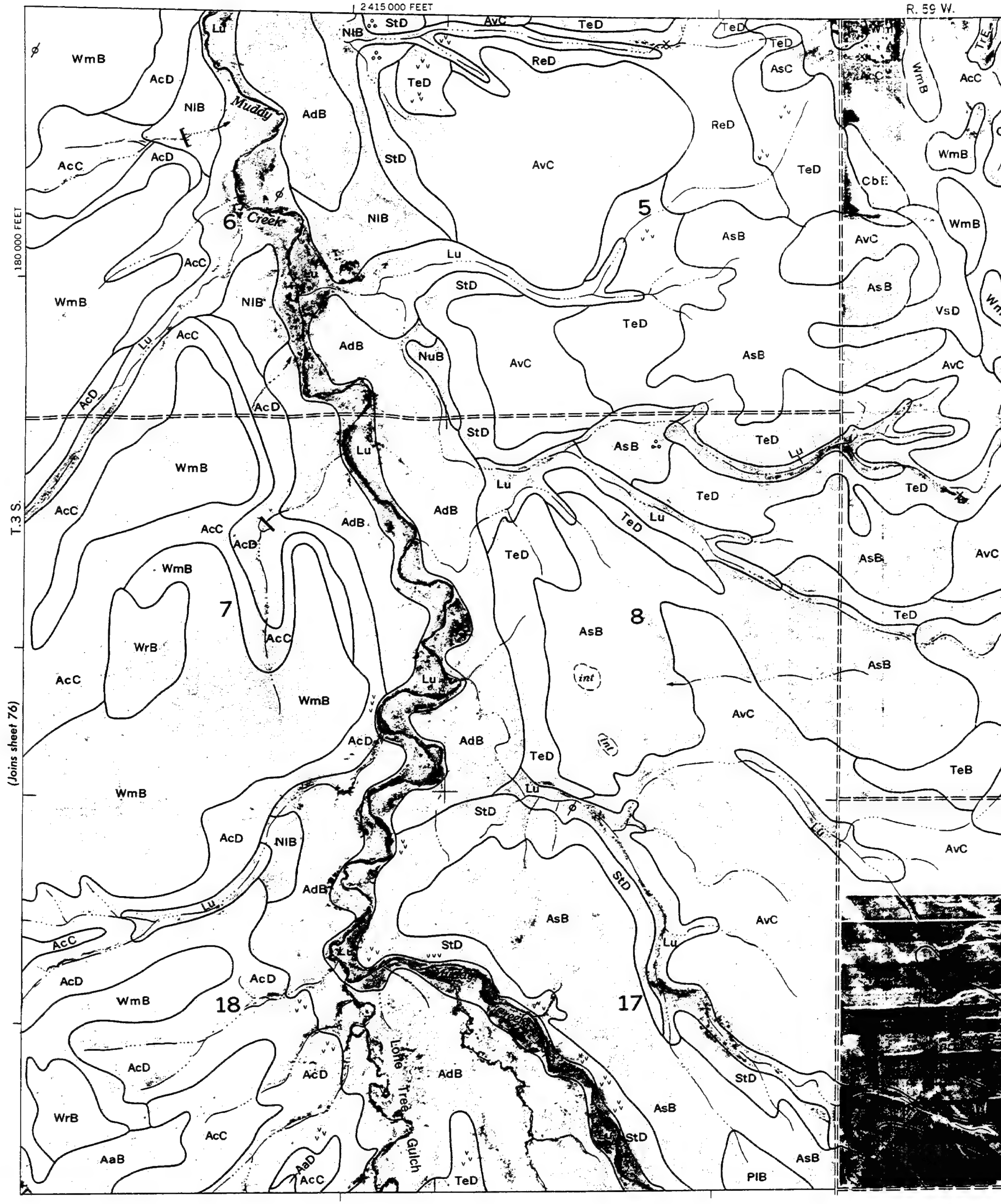
2 360 000 FEET
180 000 FEET
T.3 S.
(Joins sheet 75)
5
4
8
9
16
AcC
WmB
ReD
AcD
NIB
NuB
TtB
AsB
HIB
Lu
AsC
AaB
AdB
Sm
VaD
WEST BIJOU CREEK

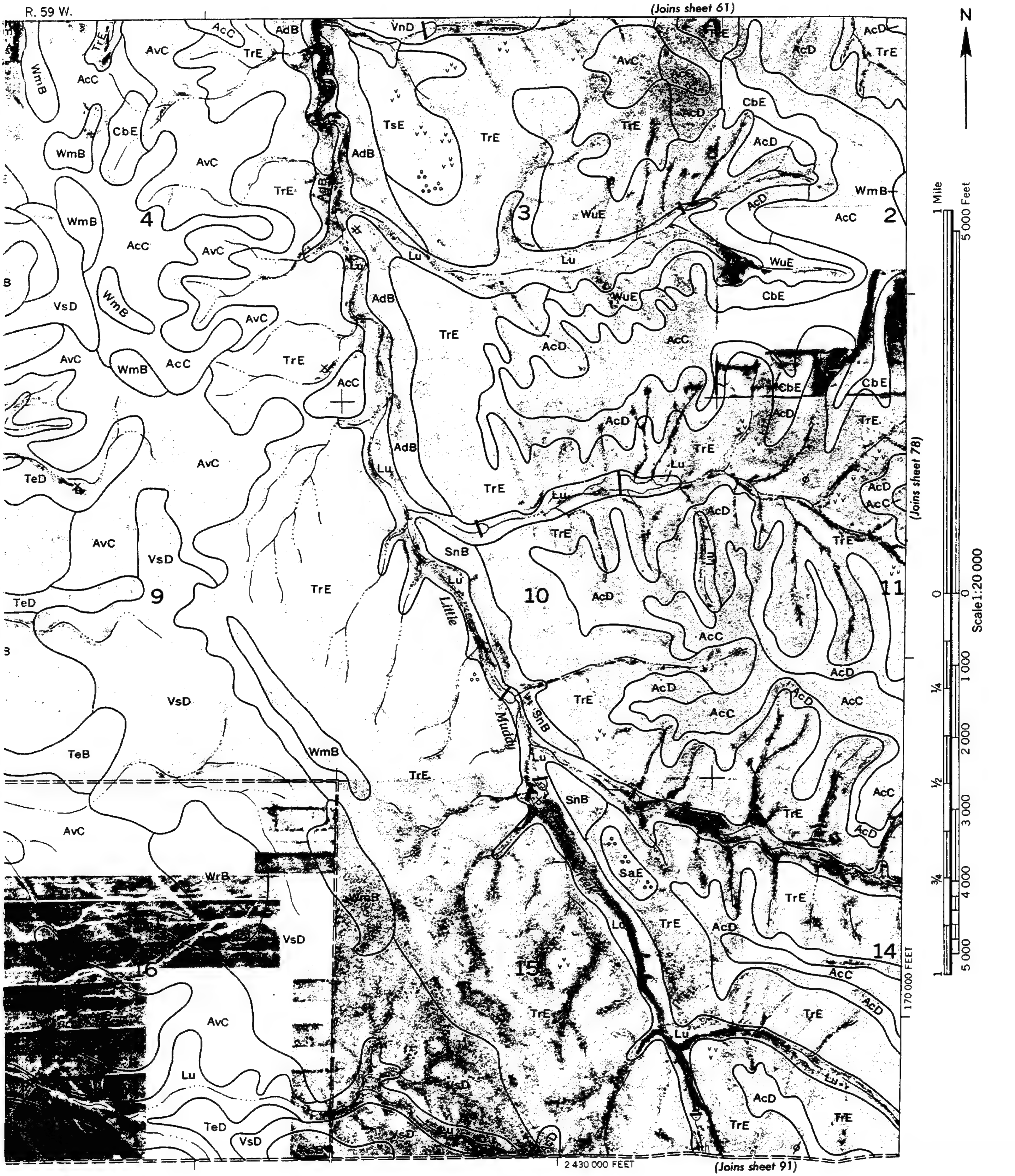

2 365 000 FEET
180 000 FEET
T.3 S.
(Joins sheet 74)
WEST BIJOU CREEK
3
2
1
10
11
12
15
14
13
NIB
HIB
Sm
Lw
HID
WrB
AvC
VoC
VnD
AdB
AcC
AsB
SnB
VaD
TtB
WmB
Lu
int

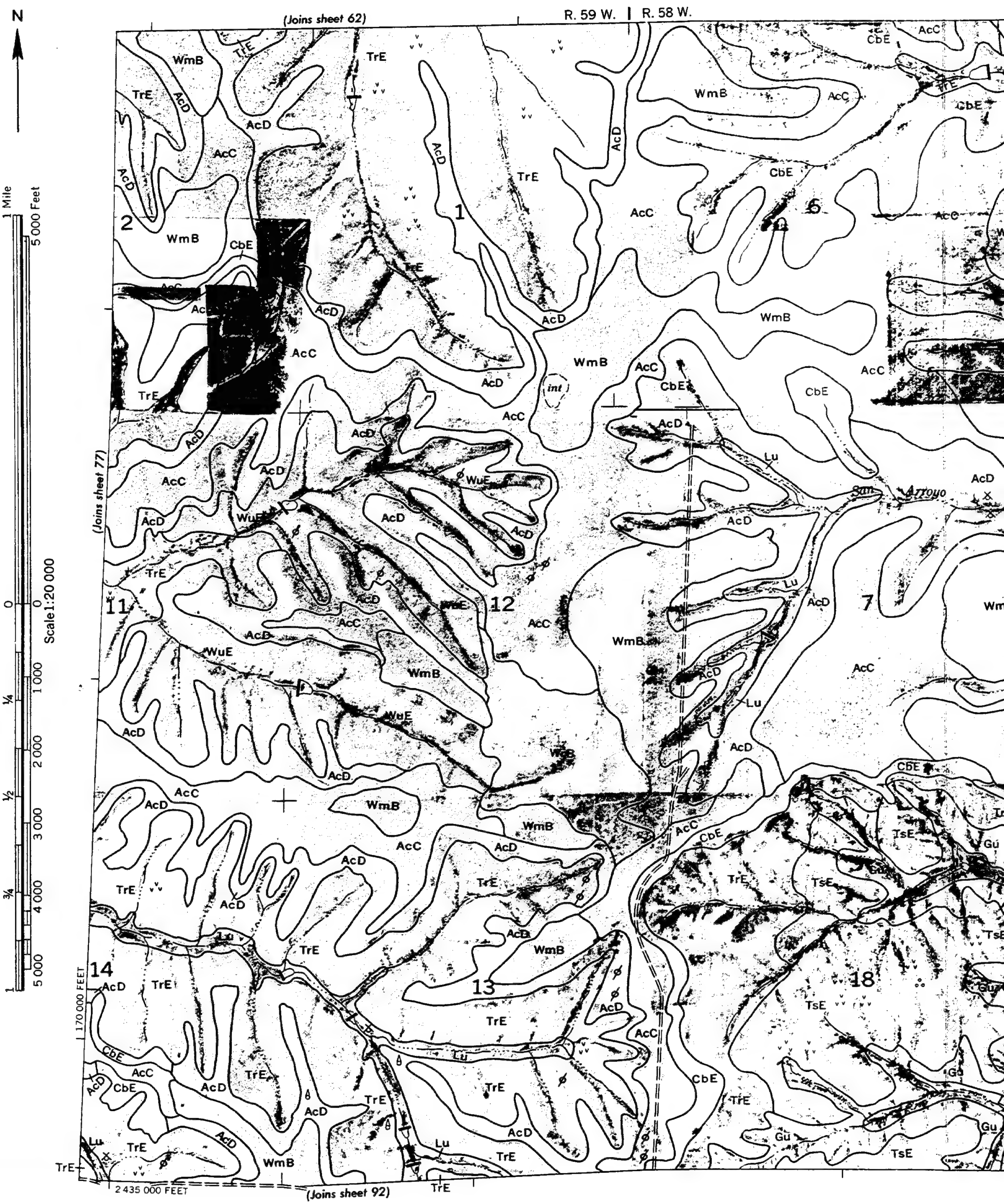

R. 61 W.
R. 60 W.
(Joins sheet 59)
N
HlD
AdB
AsC
WrB
HlB
AvC
1
Wt
AdB
HlB
HlB
NlB
Lu
Sm
6
HlB
AdB
AsC
VnD
AvC
AdB
Lu
int
Wt
Sm
VaD
VnD
AdB
AcC
AdB
AsB
SnB
AvC
AcC
VnD
VnD
AdB
CREEK
(Joins sheet 76)
12
AcC
AaB
7
AcC
int
AdB
WrB
WmB
WrB
AvC
NlB
VnD
WmB
Sm
BIJOU
AsB
AcC
AvC
int
AvC
AvC
AcC
WmB
AdB
EAST
WmB
AaB
AcC
AcC
AsB
AvC
13
int
AcC
18
WmB
Cb
AdB
AsB
AcC
AaB
17
Lu
AsB
AvC
AcC
AcC
WmB
AaB
Wt
AsB
int
1 Mile
5 000 Feet
Scale 1:20 000
170 000 FEET
(Joins sheet 89)
2 385 000 FEET

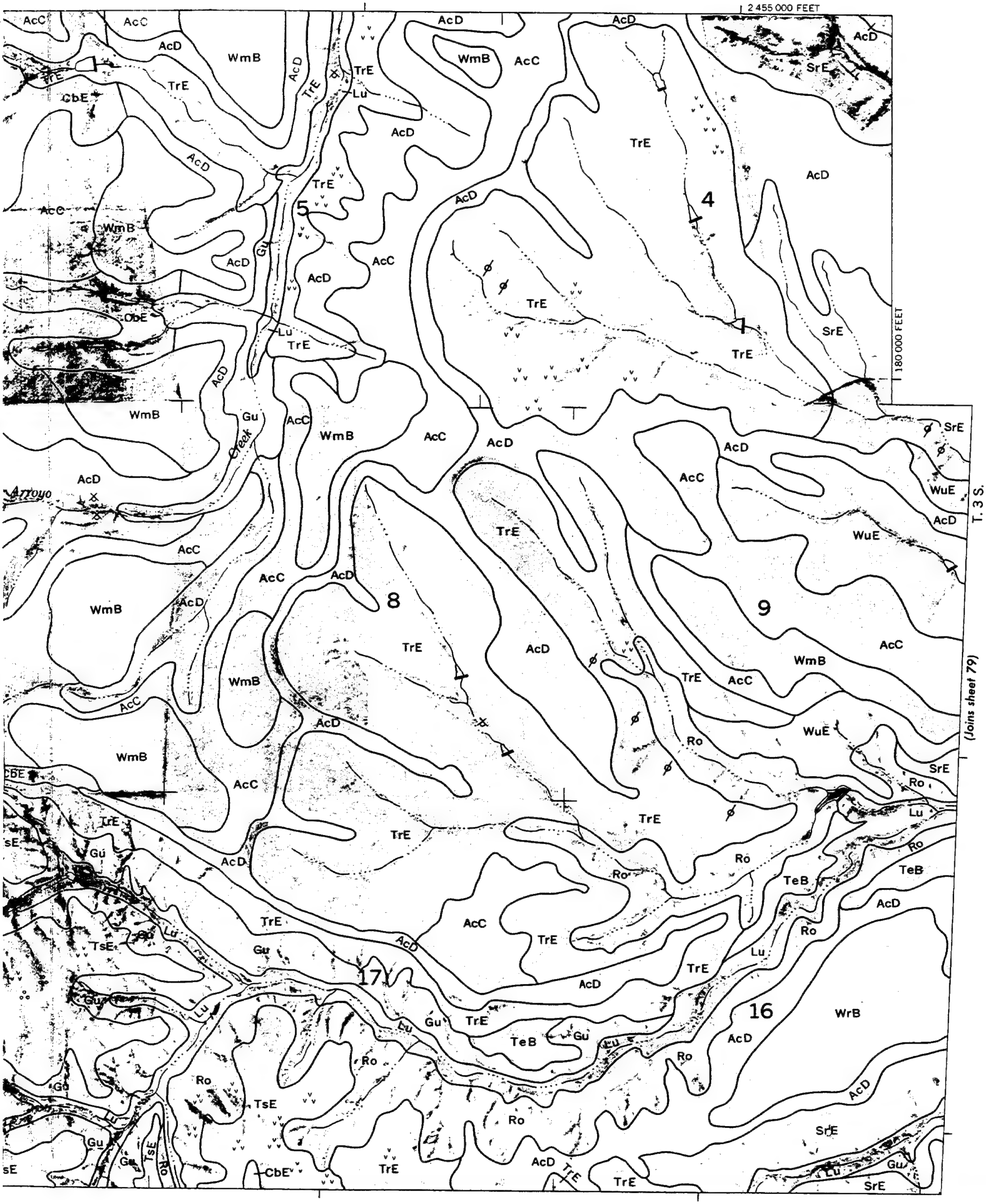

N
(Joins sheet 60)
R. 60 W.
(Joins sheet 75)
(Joins sheet 90)
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
0
1 000
2 000
3 000
4 000
5 000
170 000 FEET
2 390 000 FEET
E Bijou Cr
AvC
Bt
HlB
TtD
HlD
Lu
Sm
AdB
VaD
AcC
AsB
WmB
AcD
WrB
AcC
AsC
SnB
Wt
3
4
9
10
15
16
17

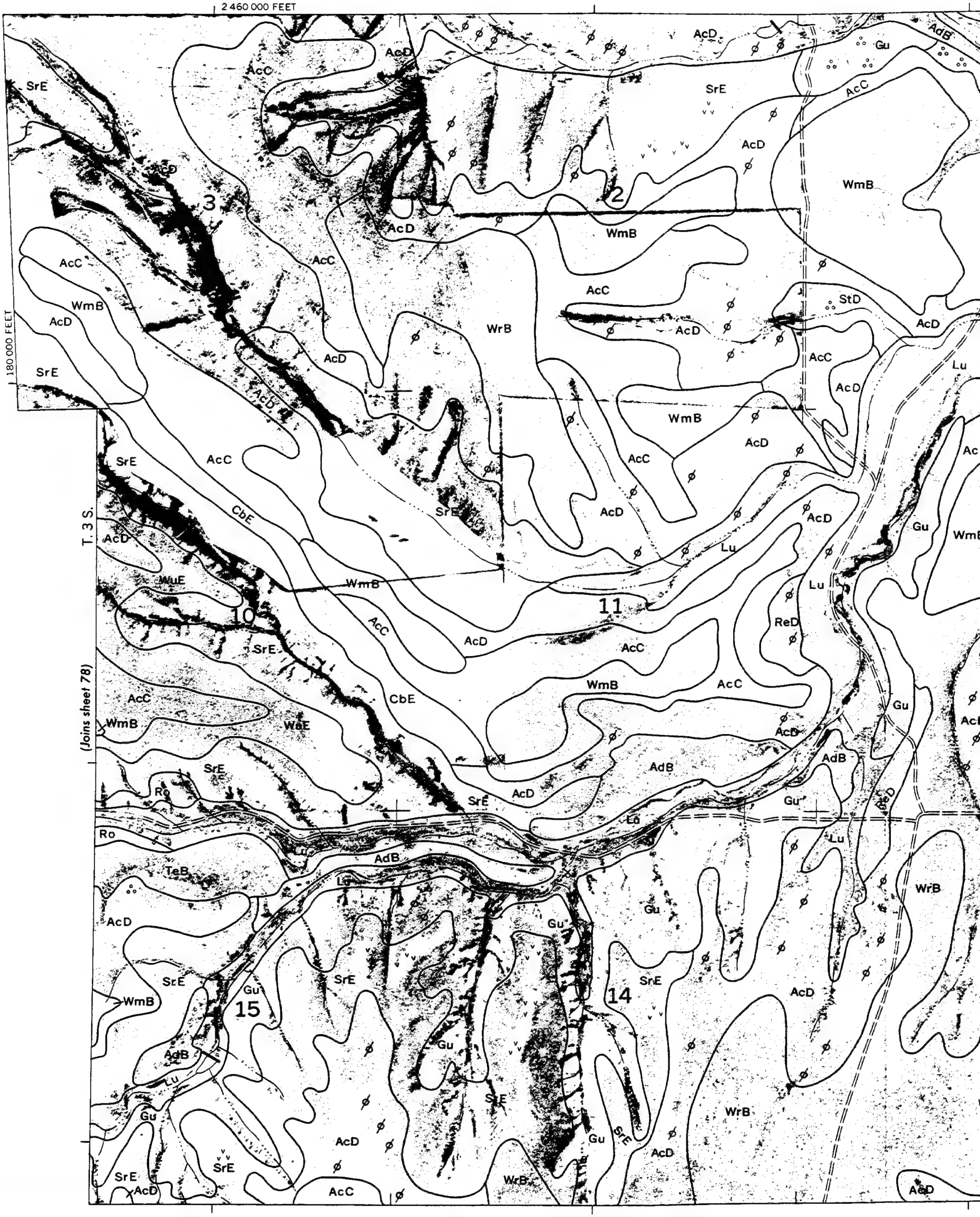

R. 60 W.
2 410 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 77)
1
2
11
12
14
AcD
AcC
WrB
WmB
AdB
WuE
AaB
Lu
CbE
AsC


2 415 000 FEET
R. 59 W.
180 000 FEET
T. 3 S.
(Joins sheet 76)
Muddy
Creek
Lone Tree Gulch
5
6
7
8
17
18
WmB
AcD
NlB
Lu
StD
AvC
TeD
ReD
AsC
AdB
AcC
AsB
CbE
VsD
NuB
WrB
TeB
AaB
AaD
PlB
int

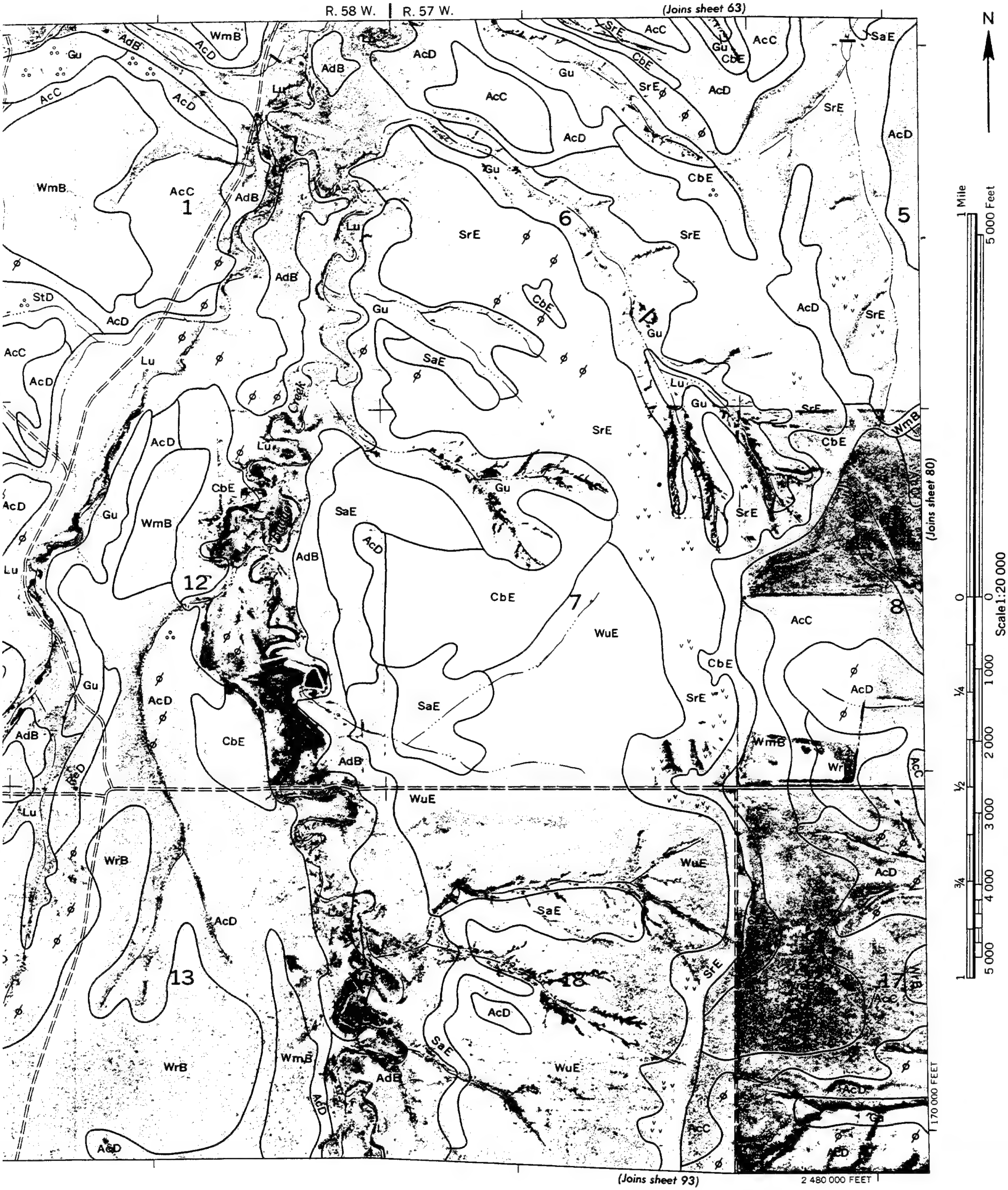

R. 59 W.
(Joins sheet 61)
N
(Joins sheet 78)
(Joins sheet 91)
2 430 000 FEET
170 000 FEET
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
4
3
2
9
10
11
16
15
14
Little
Muddy
AcC
AdB
VnD
AcD
TrE
AvC
WmB
CbE
TsE
WuE
Lu
AdB
VsD
TeD
TeB
SnB
SaE
WrB

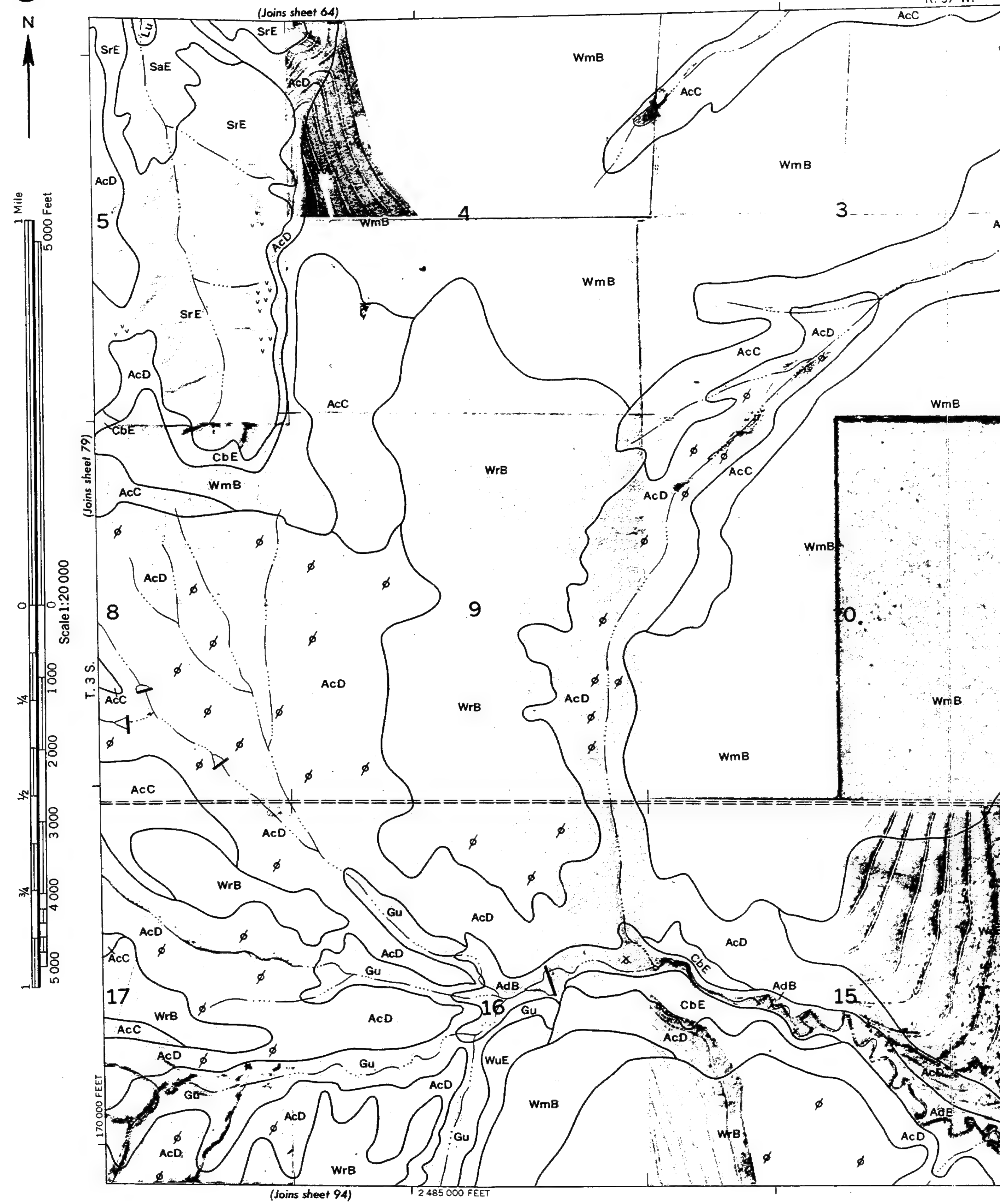

N
1 Mile
5 000 Feet
0
0
Scale 1:20 000
1/4
1 000
2 000
1/2
3 000
3/4
4 000
5 000
1
(Joins sheet 62)
R. 59 W.
R. 58 W.
(Joins sheet 77)
(Joins sheet 92)
170 000 FEET
2 435 000 FEET
San Arroyo
1
2
6
7
11
12
13
14
18
WmB
TrE
AcD
AcC
CbE
WuE
Lu
TsE
Gu
int

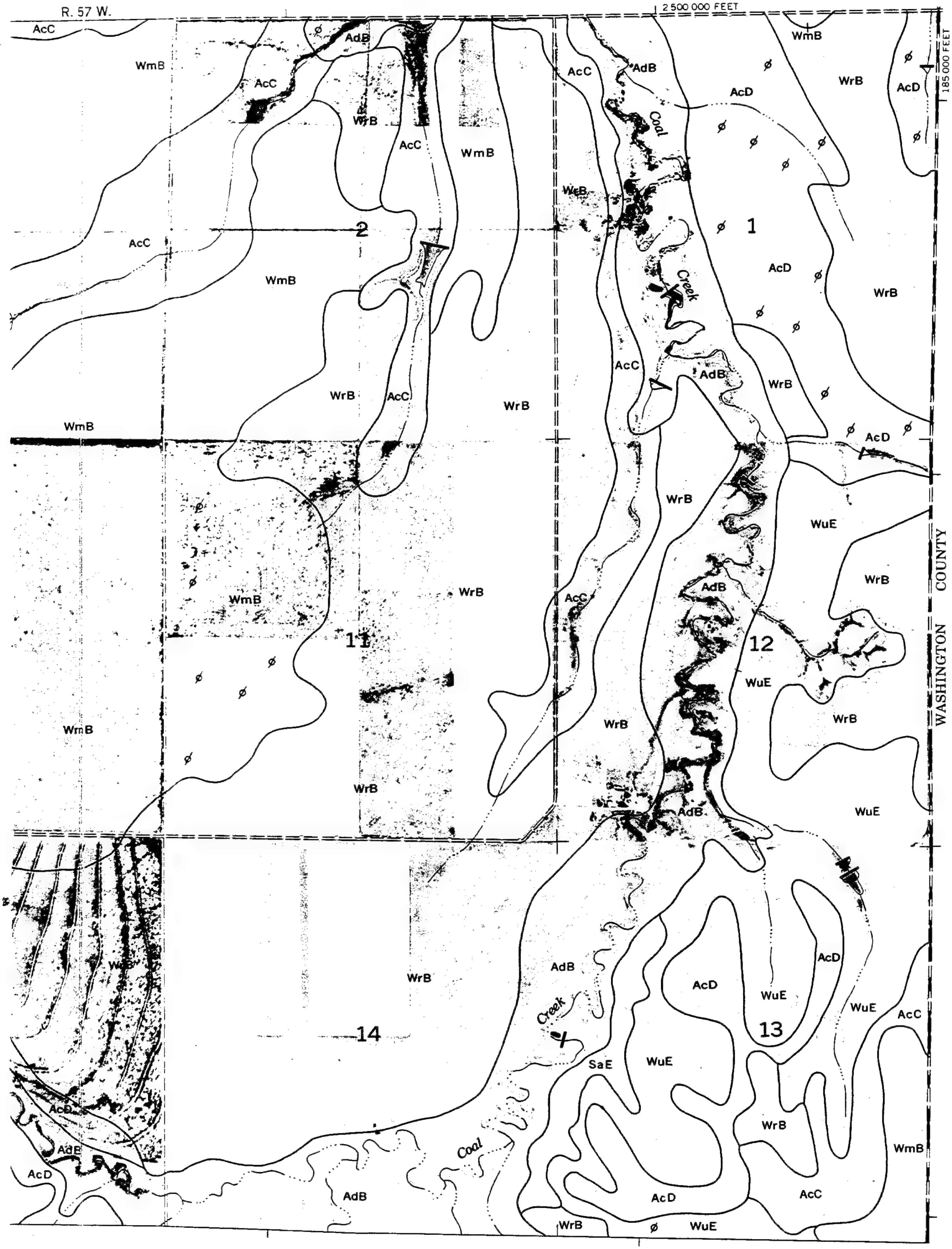

2 455 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 79)
Arroyo
Creek
4
5
8
9
16
17
AcC
AcD
WmB
TrE
CbE
Lu
Gu
SrE
WuE
Ro
TeB
TsE
WrB


2 460 000 FEET
180 000 FEET
T. 3 S.
(Joins sheet 78)
SrE
AcC
AcD
WmB
WrB
CbE
WuE
StD
Lu
Gu
AdB
ReD
Ro
TeB
3
2
10
11
14
15

COLORADO — SHEET NUMBER 79

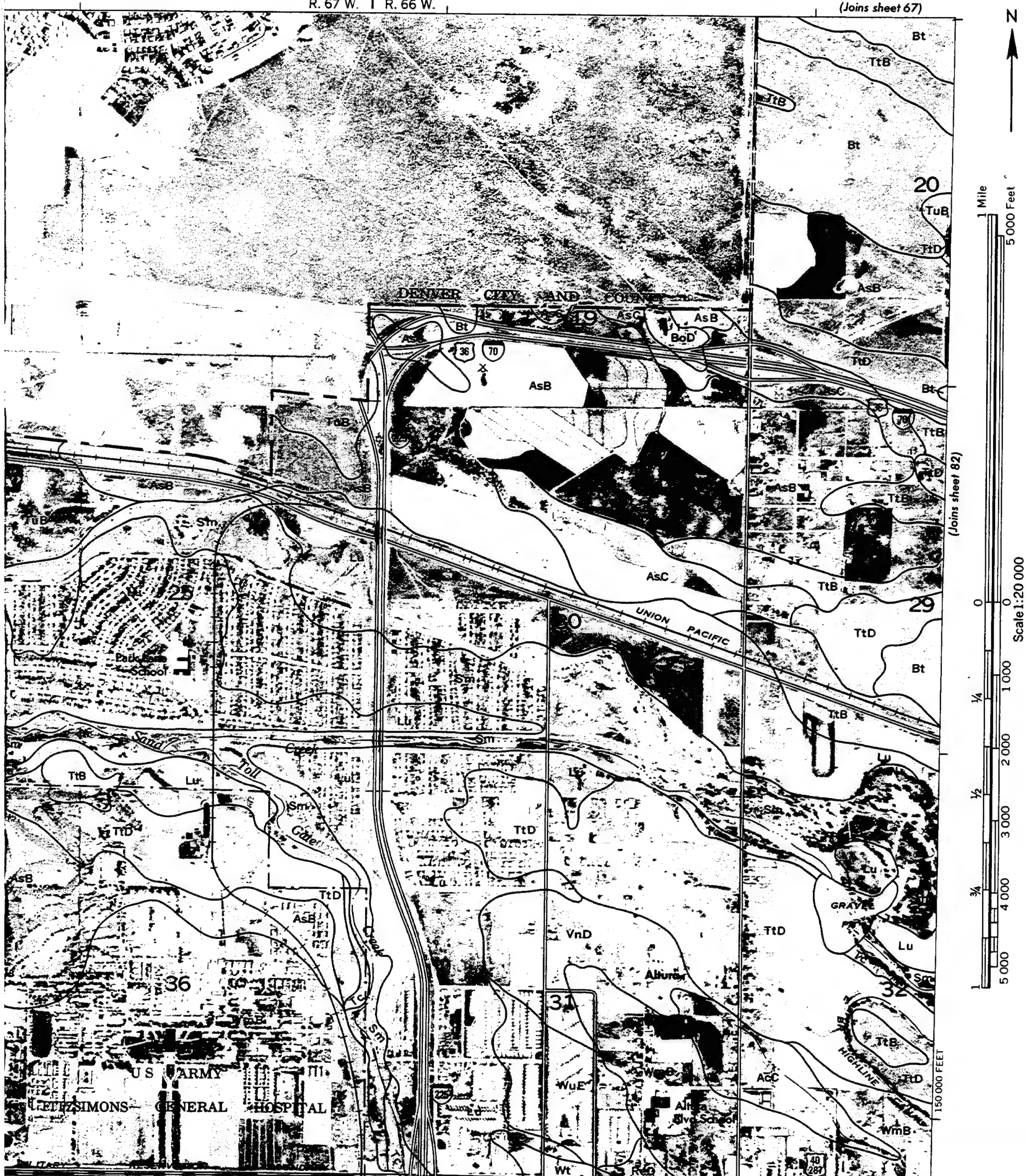



N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
R. 57 W.
(Joins sheet 64)
(Joins sheet 79)
(Joins sheet 94)
T. 3 S.
170 000 FEET
2 485 000 FEET
5
4
3
8
9
10
17
16
15
SrE
Lu
SaE
AcD
AcC
WmB
WrB
CbE
Gu
AdB
WuE


R. 57 W.
2 500 000 FEET
185 000 FEET
WASHINGTON COUNTY
AcC
AdB
WmB
AcC
WrB
AcC
WmB
AcC
AdB
Coal
Creek
AcD
WrB
AcD
WmB
2
1
AcC
WmB
WrB
AcD
WrB
AcC
AdB
WrB
WrB
AcC
WrB
WmB
AcD
WrB
WuE
WrB
AdB
WmB
AcC
WrB
11
12
WuE
WrB
WmB
WrB
WrB
WuE
AdB
WrB
AdB
AcD
WuE
WuE
AcC
Creek
14
13
SaE
WuE
AcD
AdB
WrB
WmB
Coal
AcD
AdB
AcD
AcC
WrB
WuE

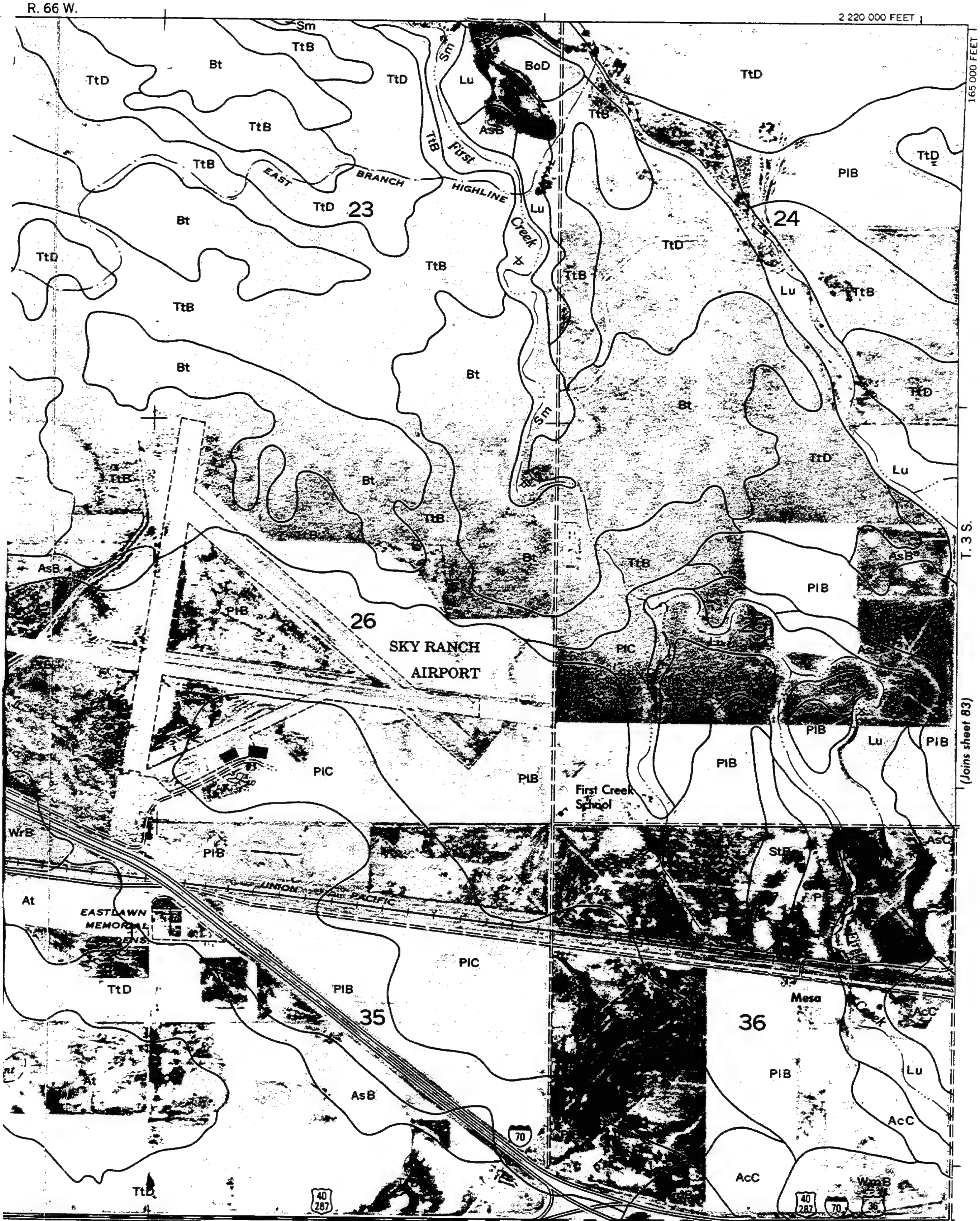

2 175 000 FEET
160 000 FEET
T. 3 S.
Lu
26
Sm
Lu
Tc
TtB
AsC
AsB
WmB
TtD
COUNTY
AND
CITY
DENVER
34
35
AURORA
Montview School
North Jr. High School
AsB
WmB
AcC
WmB
Park School
ARAPAHOE
COUNTY
FITZSIMONS
U S
Park Lane School
Sm
TtB
AsB

R. 67 W. | R. 66 W. (Joins sheet 67)

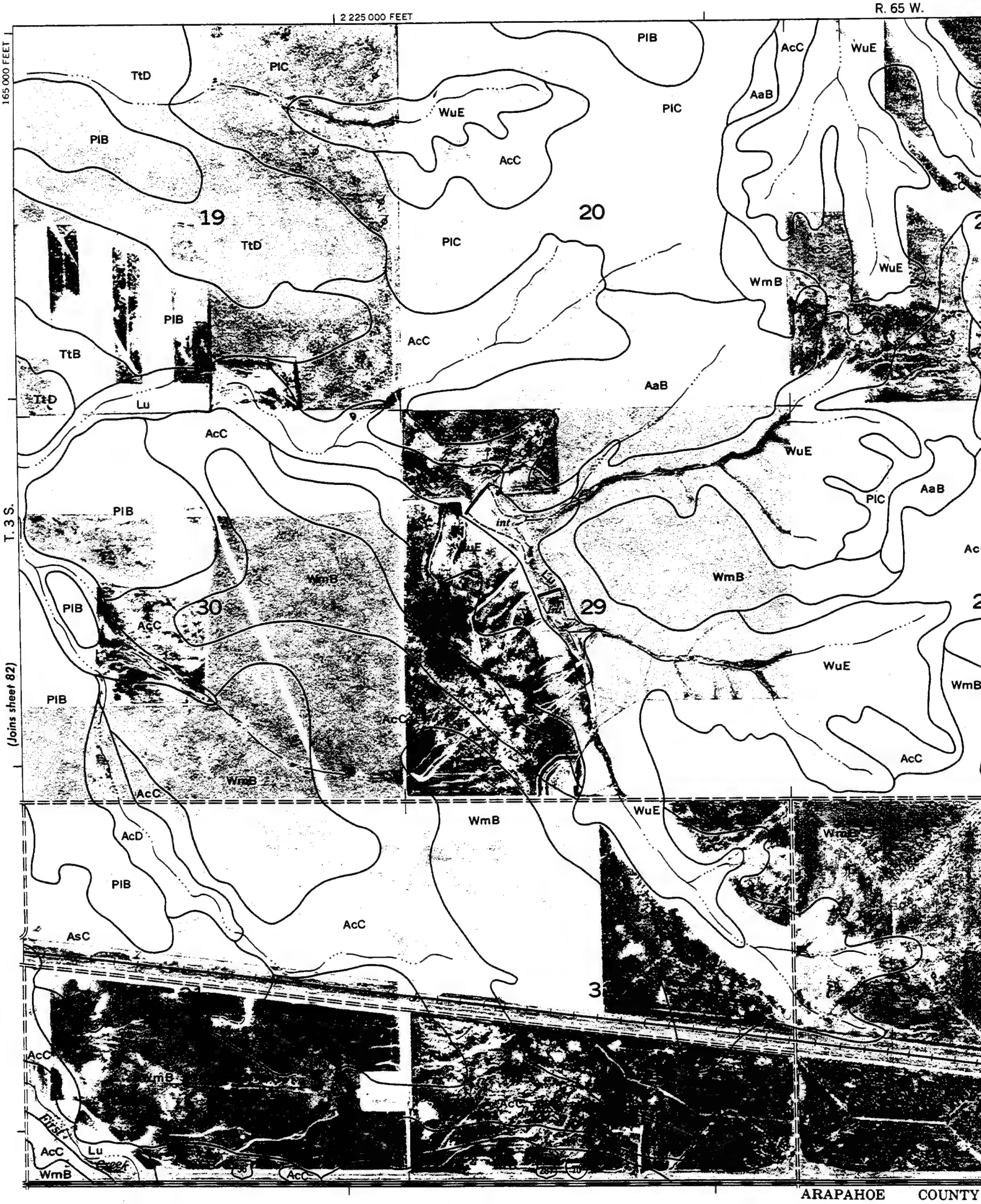


AHOE COUNTY

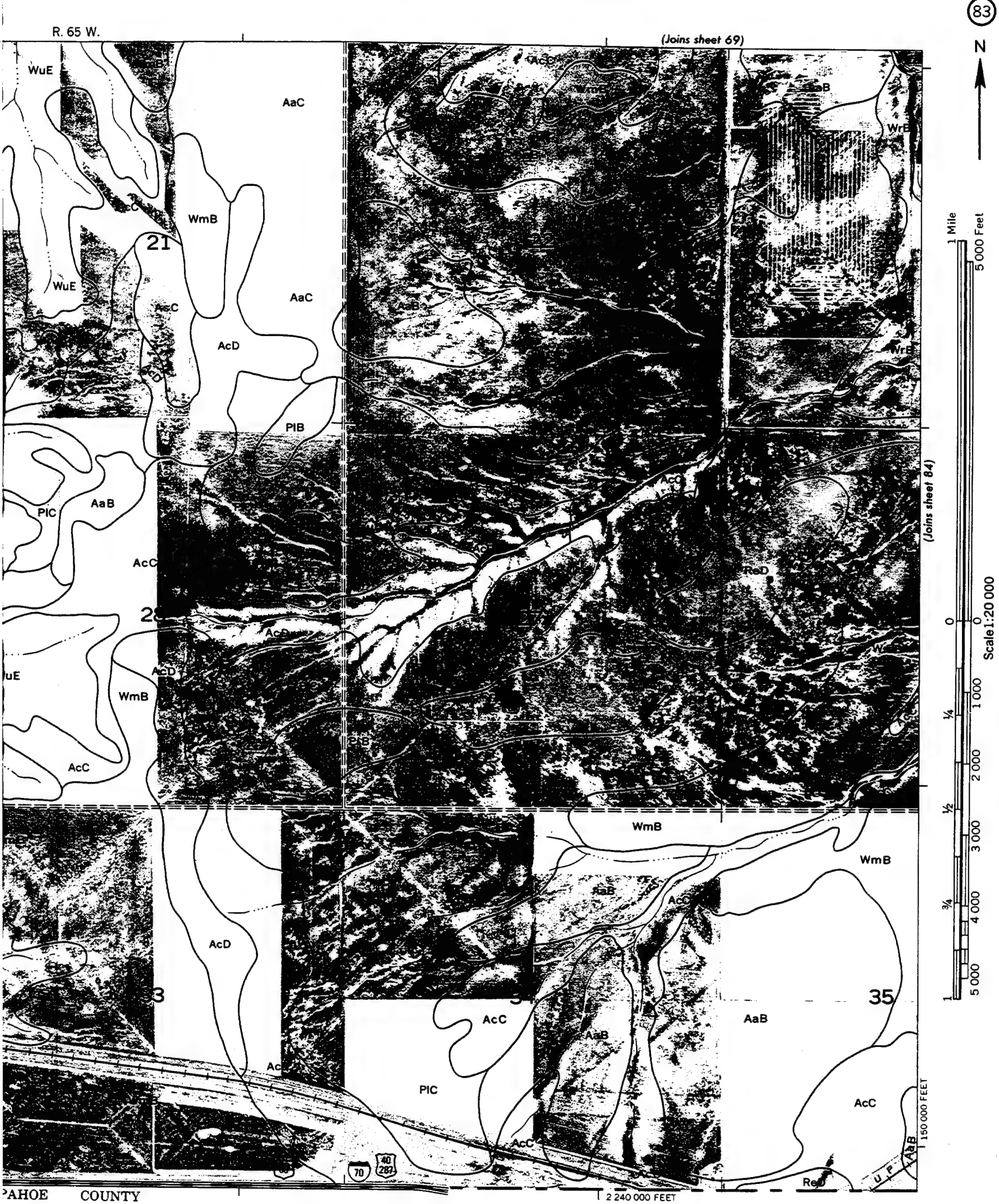

N
(Joins sheet 68)
R. 66 W.
(Joins sheet 81)
1 Mile
5 000 Feet
0
Scale 1:20 000
1000
¼
2 000
½
3 000
4 000
¾
5 000
1
TtB
TuB
Bt
TtD
AsC
AsB
ArB
PlB
At
WrB
VoB
Sm
Lu
WmB
ReD
Wt
20
21
22
29
34
HIGHLINE LATERAL
HIGHLINE CANAL
36
70
32
40
287
150 000 FEET
2 200 000 FEET
ARAPAHOE COUNTY


R. 66 W.
2 220 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 83)
23
24
26
35
36
SKY RANCH
AIRPORT
EAST BRANCH HIGHLINE
First Creek
First Creek School
UNION PACIFIC
EASTLAWN MEMORIAL GARDENS
Mesa Creek
TtD
TtB
Bt
Sm
BoD
Lu
AsB
PlB
PlC
AsC
AcC
StB
WrB
WmB
At
70
40
287
36

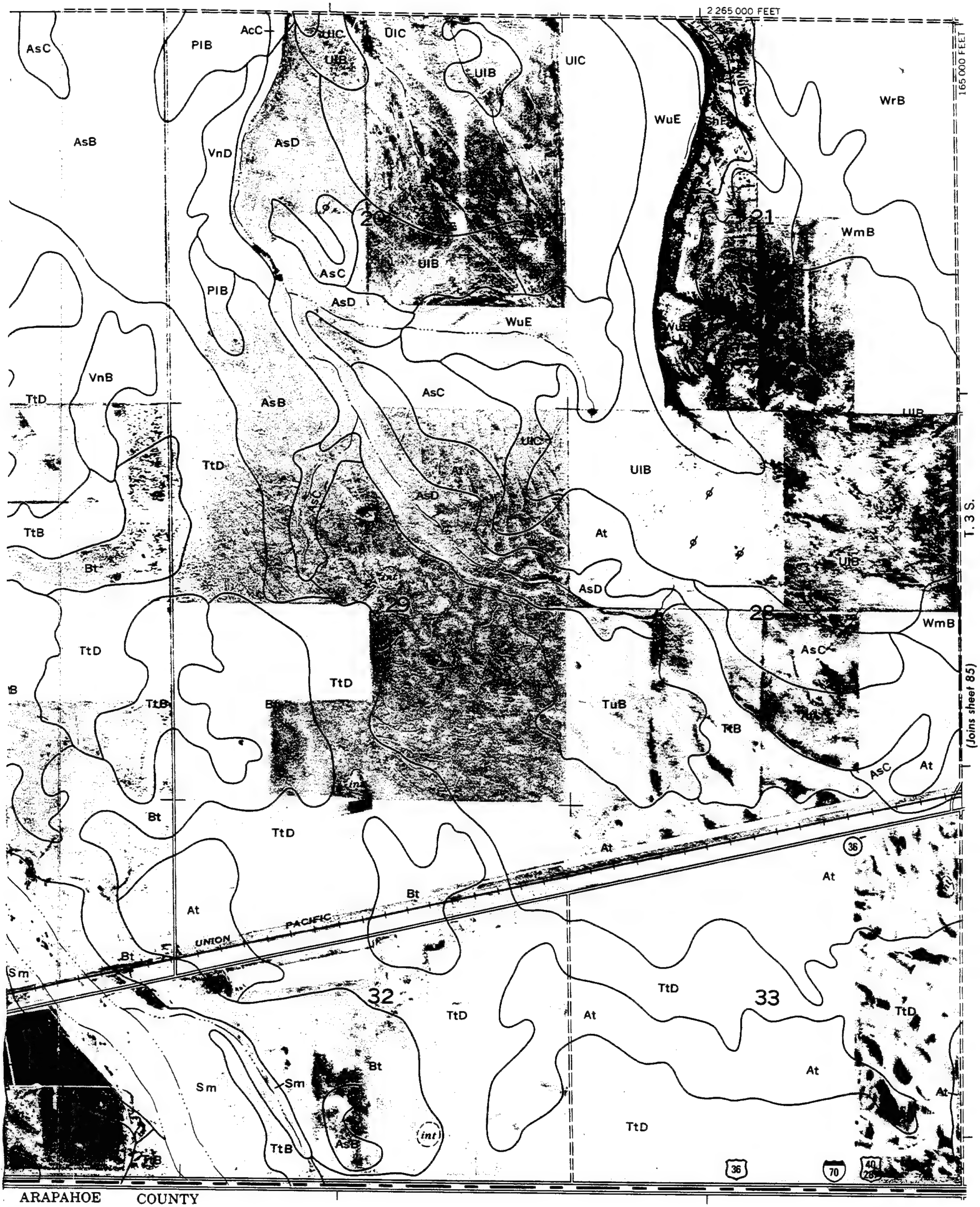
COUNTY

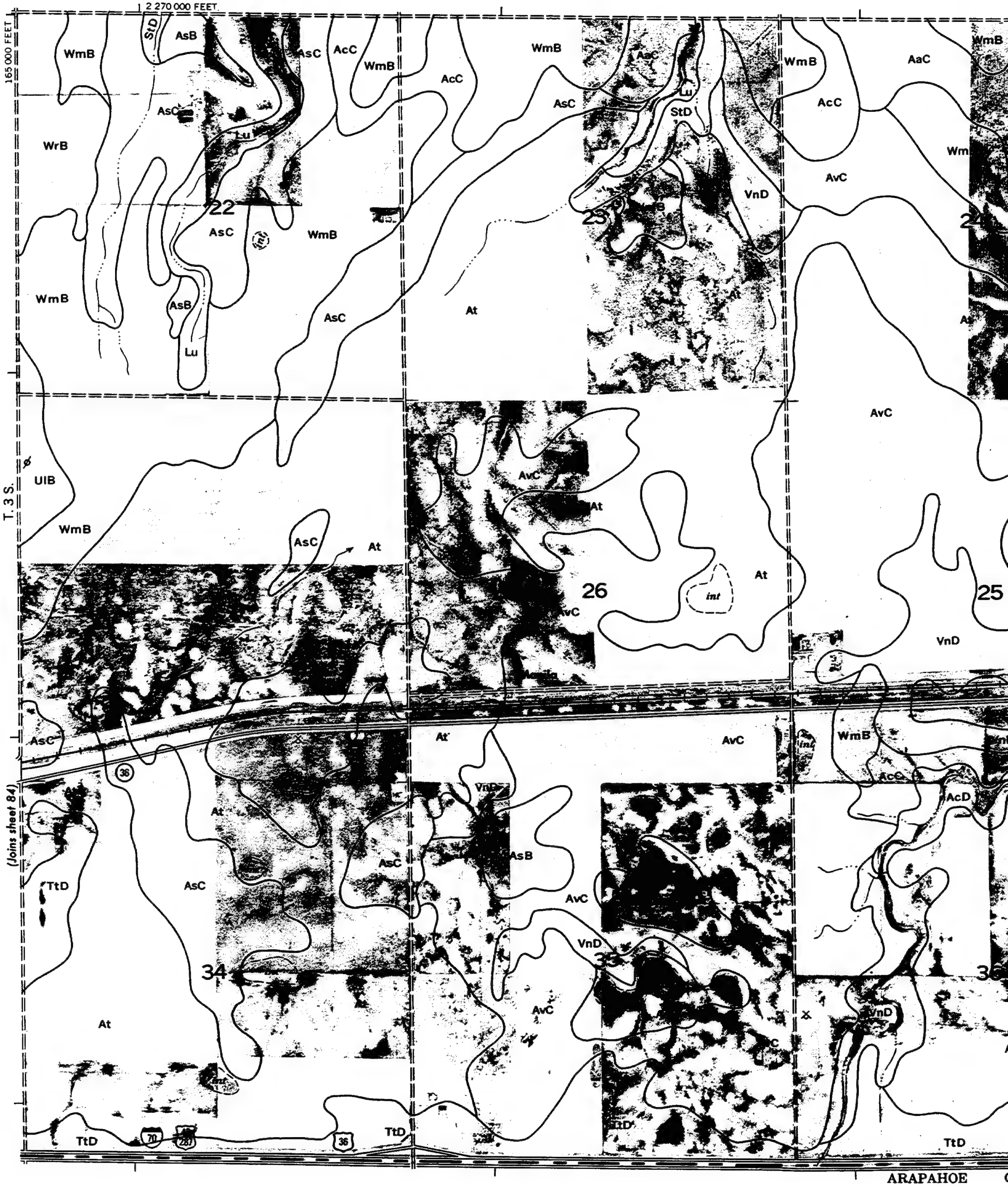

2 225 000 FEET
R. 65 W.
165 000 FEET
T. 3 S.
(Joins sheet 82)
19
20
29
30
TtD
PlC
PlB
WuE
AcC
AaB
TtB
Lu
WmB
AcD
AsC
int
First Creek
ARAPAHOE COUNTY

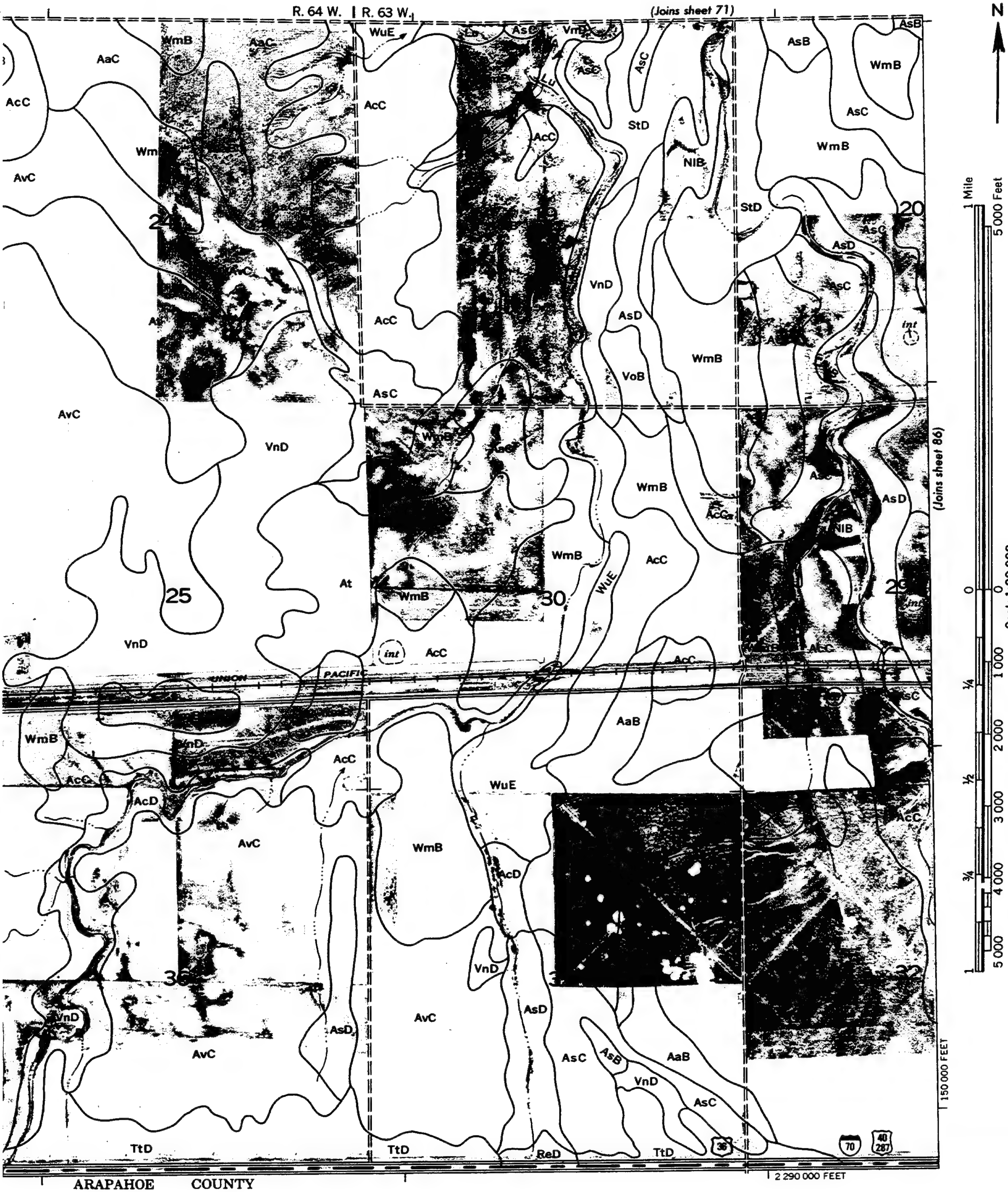
COLORADO — SHEET NUMBER 83

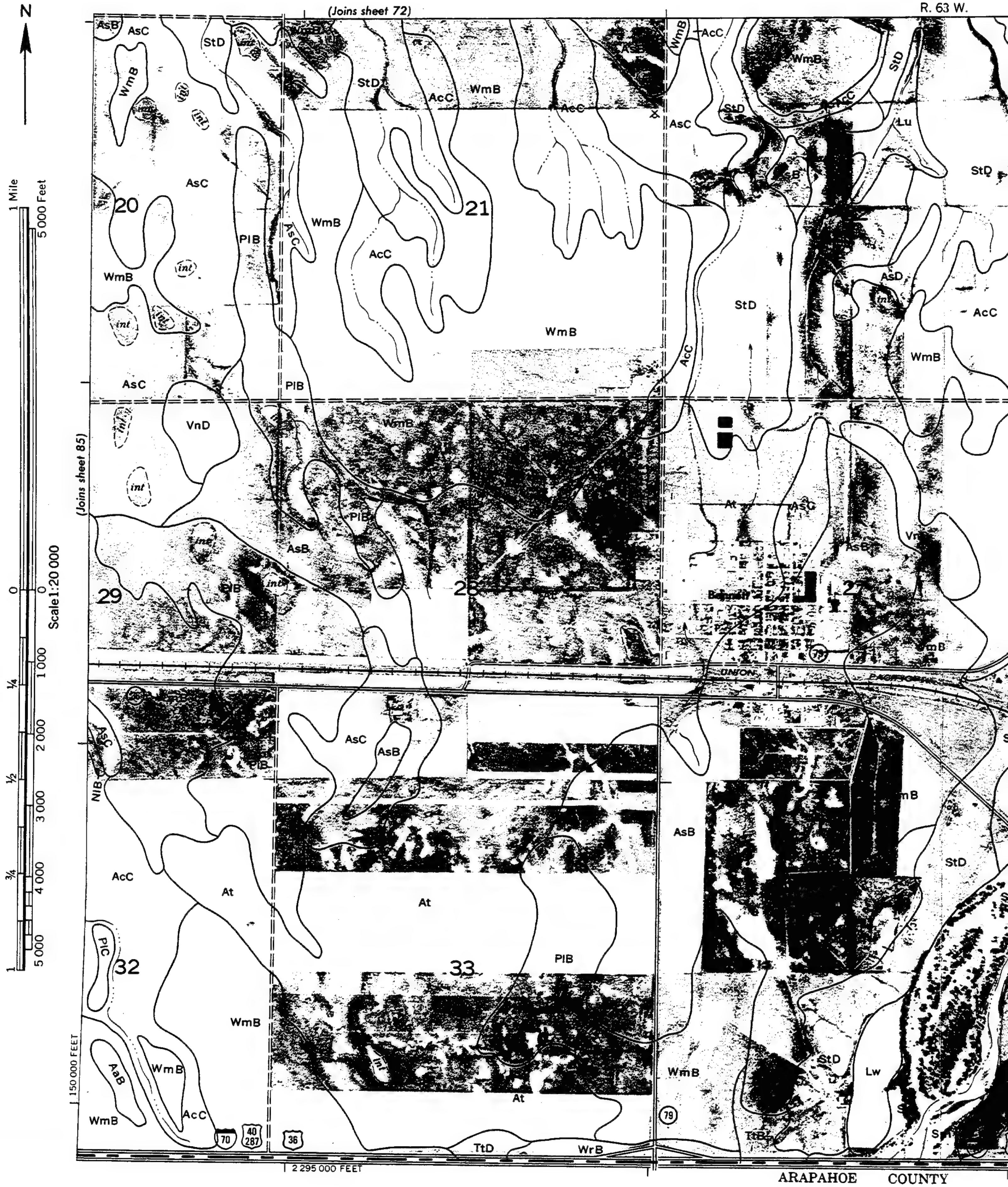


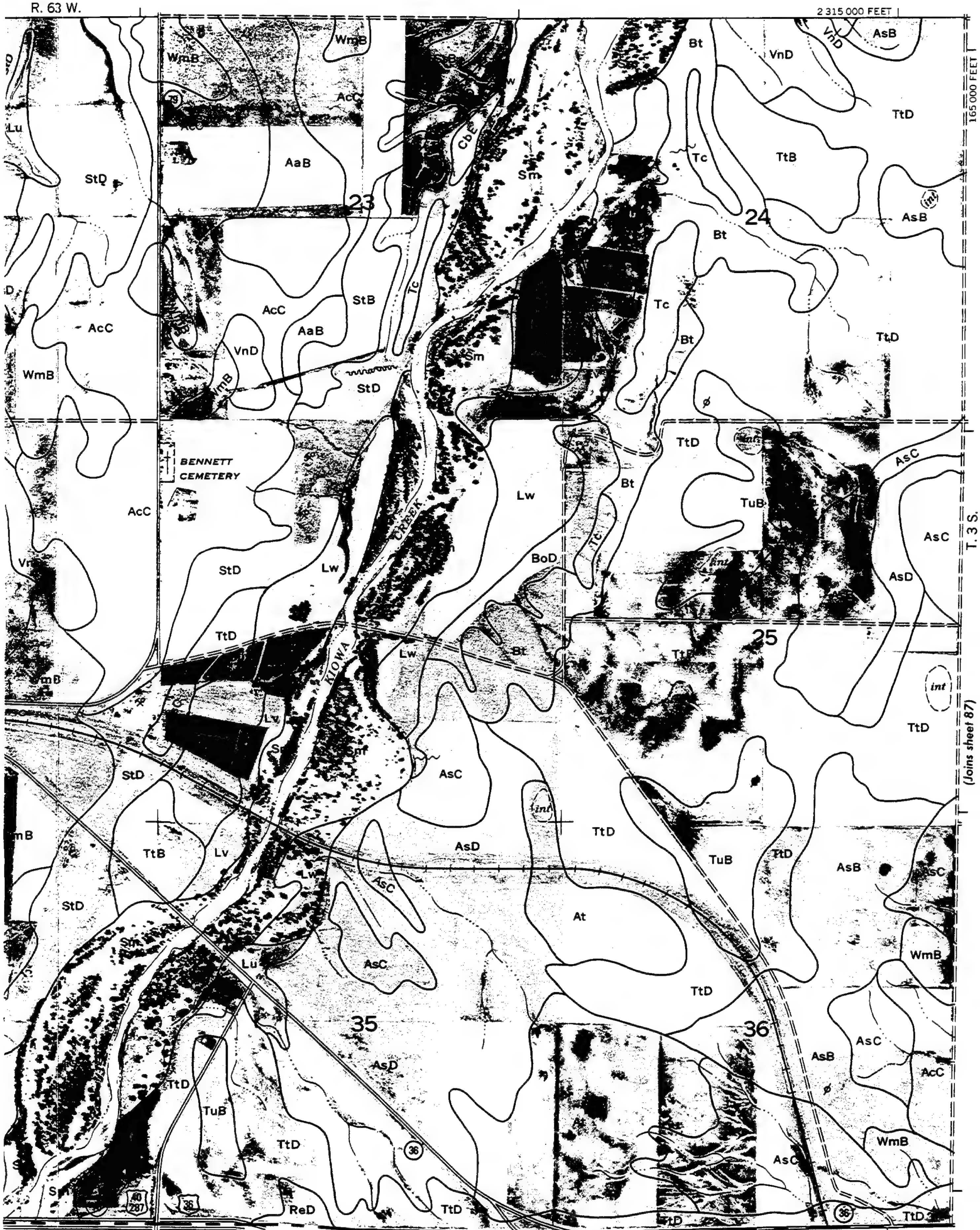

N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
0
1 000
2 000
3 000
4 000
5 000
(Joins sheet 70)
(Joins sheet 83)
R. 65 W.
R. 64 W.
150 000 FEET
2 245 000 FEET
ARAPAHOE
23
24
19
25
35
36
Watkins
BOX ELDER CREEK
36
70
40
287
SnA
NlA
Lu
TuB
TtB
Sm
TtD
AsB
AsC
At
Bt
WrB
G.P.
Vn
AsC
NuA
AdB
NlB
AvC
Lw
WmB
AaB
AcC
TuC
PlC

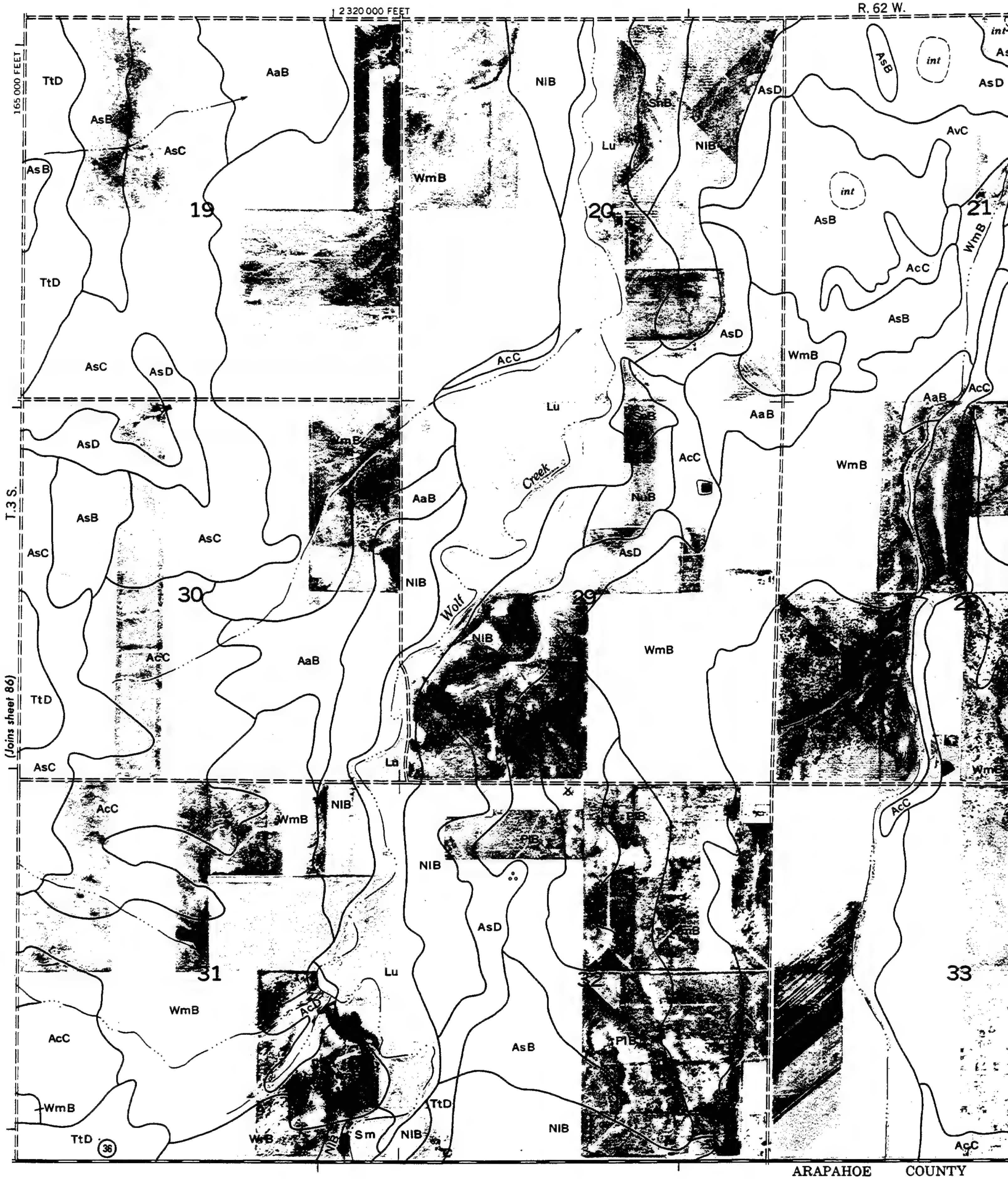

2 265 000 FEET
165 000 FEET
AsC
PlB
AcC
UlC
UlB
UlC
UlB
UlC
AsB
VnD
AsD
WuE
ShE
WrB
20
21
AsC
UlB
WmB
PlB
AsD
WuE
WuE
VnB
TtD
AsB
AsC
UlB
UlC
TtD
UlB
TtB
AsD
At
T. 3 S.
Bt
AsD
UlB
29
28
WmB
TtD
AsC
TtD
TuB
TtB
(Joins sheet 85)
Bt
TtB
AsC
At
Bt
TtD
At
36
At
Bt
At
UNION
PACIFIC
Bt
Sm
32
TtD
TtD
33
At
TtD
Sm
Sm
Bt
At
At
TtB
AsB
int
TtD
TtB
36
70
40
287
ARAPAHOE
COUNTY

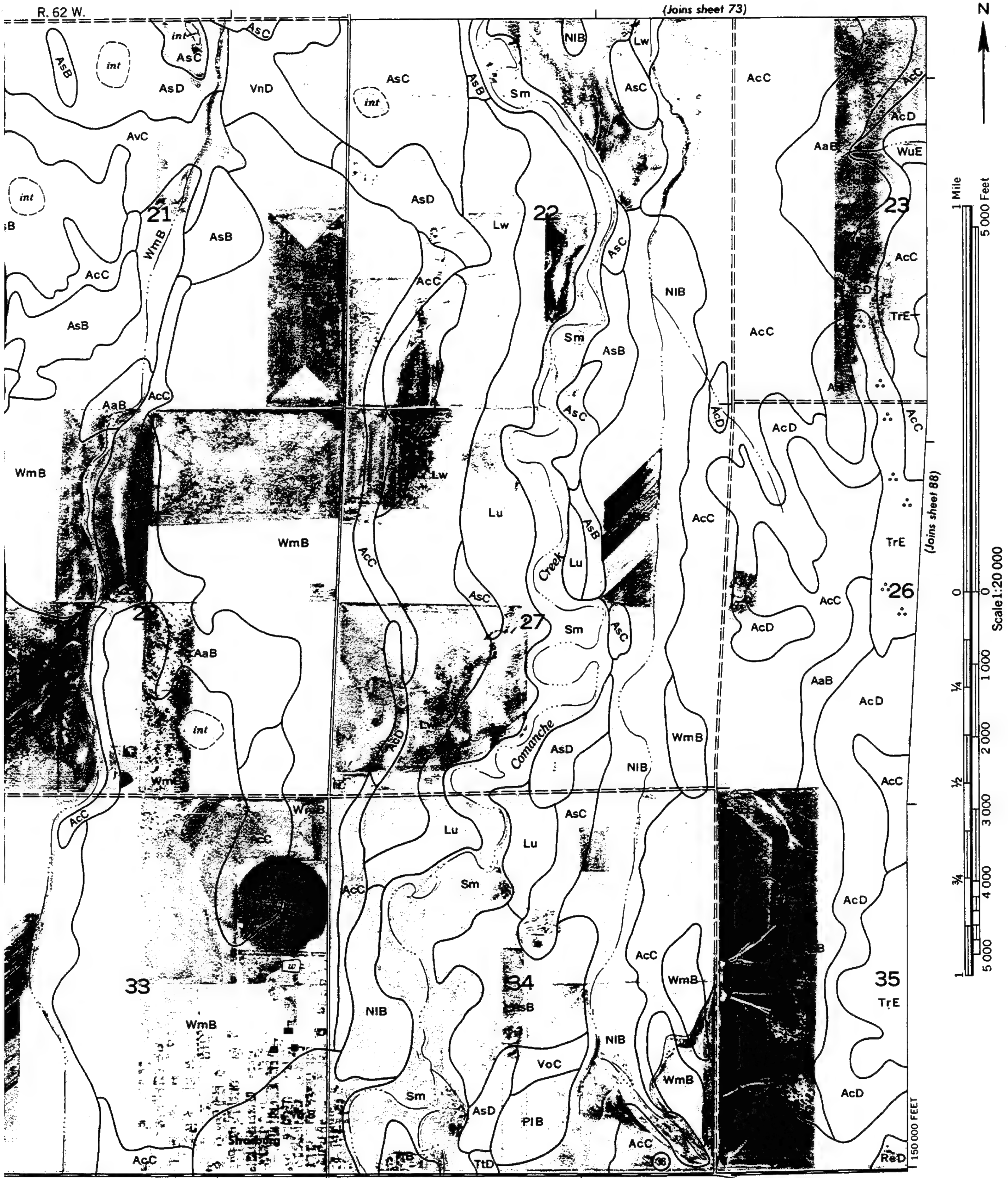

1 2 270 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 84)
WmB
StD
AsB
AsC
AcC
AaC
WrB
Lu
22
23
24
25
26
34
35
int
At
AvC
VnD
UlB
AcD
TtD
70
287
36
ARAPAHOE


N
R. 64 W.
R. 63 W.
(Joins sheet 71)
(Joins sheet 86)
WuE
AsC
VmB
AsB
WmB
AaC
AcC
StD
NlB
AsC
Wm
AvC
AsC
WmB
24
AcC
At
AcC
VnD
AsD
StD
20
AsD
AsC
int
WmB
VoB
AsC
AvC
VnD
WmB
AsC
WmB
AcGa
AsD
NlB
At
WmB
AcC
25
WuE
At
WmB
30
29
int
VnD
int
AcC
AcC
AcC
UNION
PACIFIC
AsC
WmB
VnD
AaB
AcC
AcD
WuE
AvC
WmB
AcC
AcD
VnD
36
32
VnD
AsD
AvC
AsD
AvC
AsC
AsB
AaB
VnD
AsC
TtD
TtD
ReD
TtD
36
70
40
287
ARAPAHOE COUNTY
2 290 000 FEET
150 000 FEET
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
Scale 1:20 000

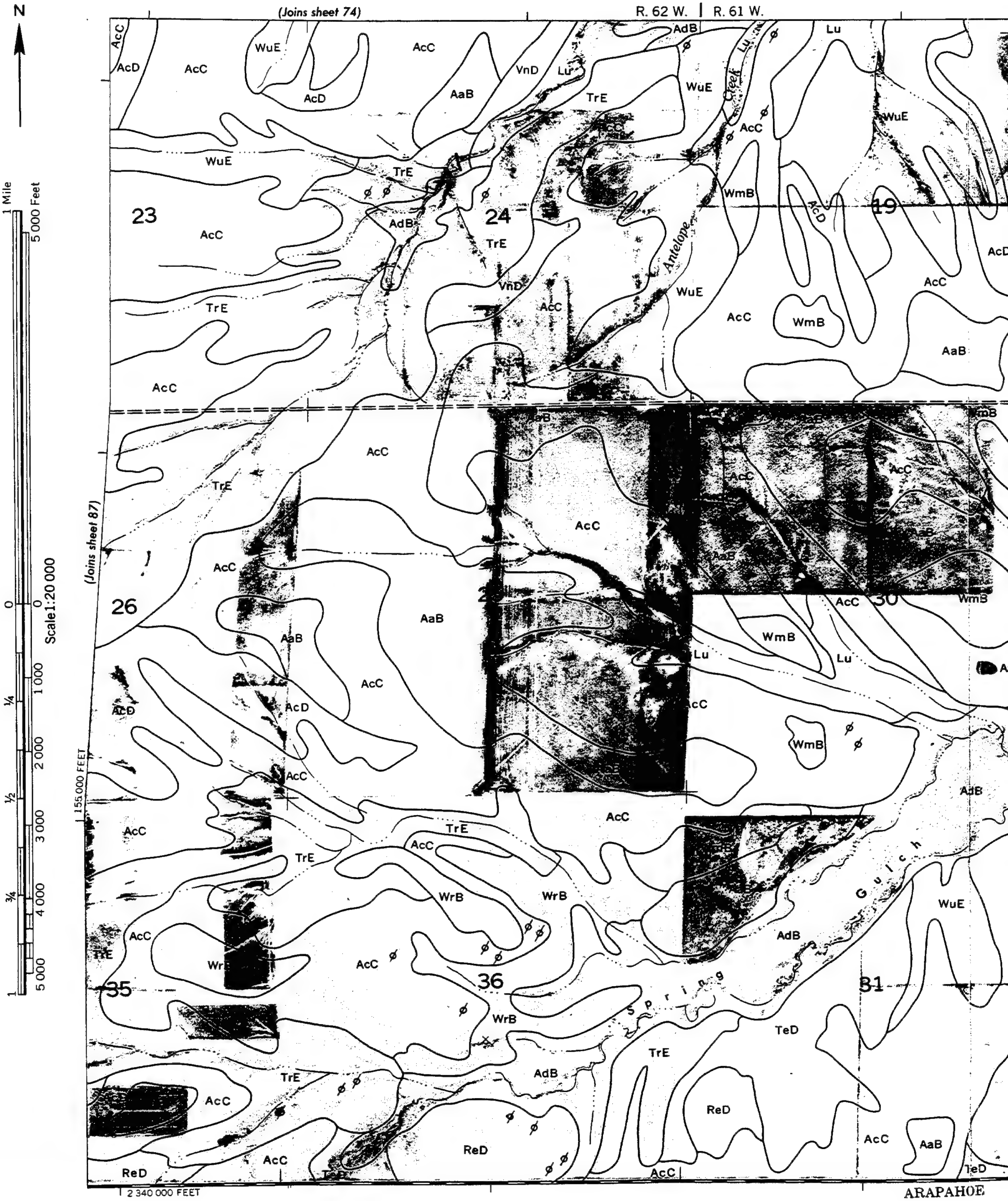

N
(Joins sheet 72)
R. 63 W.
(Joins sheet 85)
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
150 000 FEET
2 295 000 FEET
20
21
29
32
33
AsB
AsC
StD
WmB
AcC
PlB
AsD
Lu
VnD
At
NlB
PlC
AaB
Lw
TtD
WrB
UNION
PACIFIC
70
40
287
36
79
ARAPAHOE COUNTY

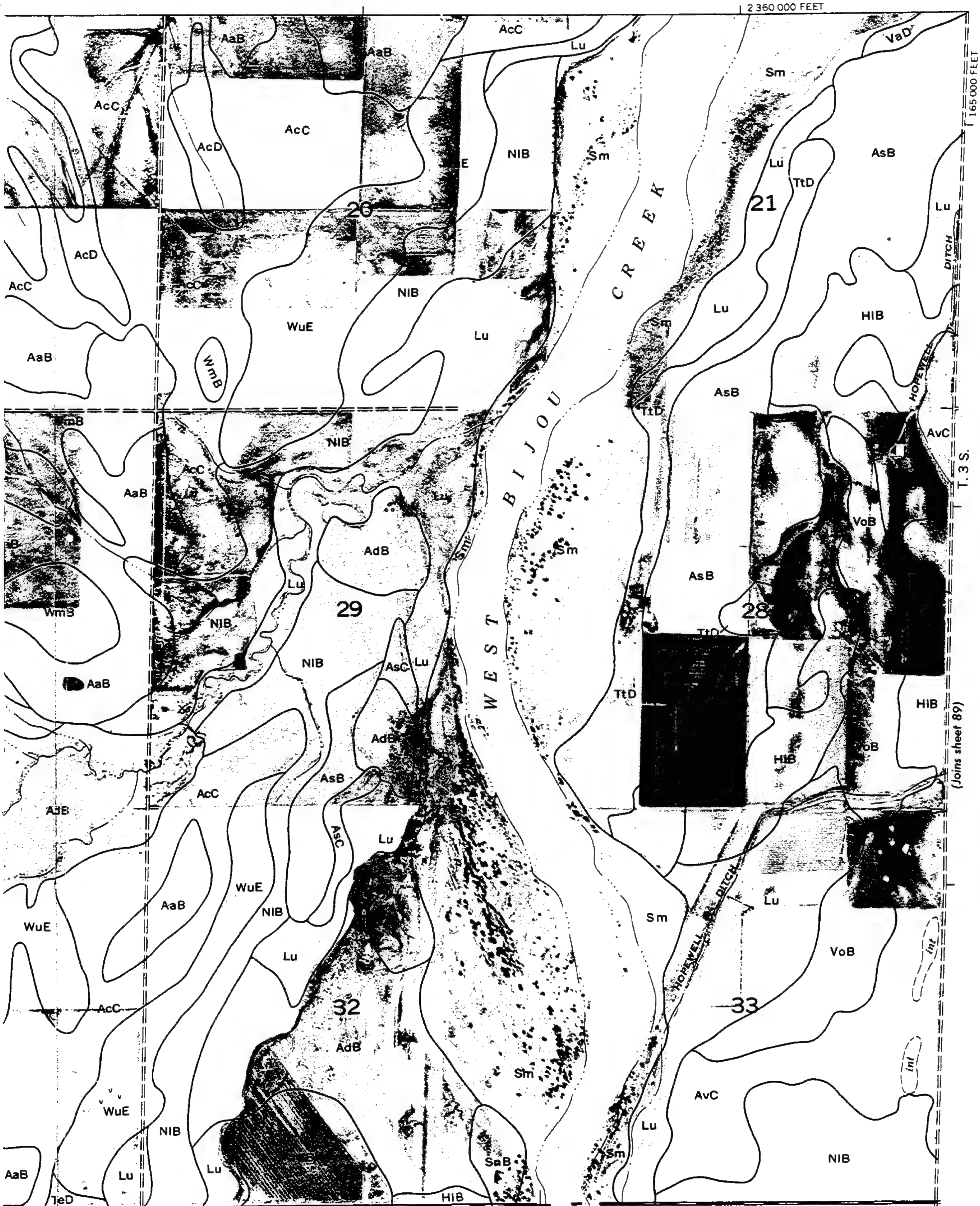

R. 63 W.
2 315 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 87)
BENNETT CEMETERY
KIOWA CREEK
23
24
25
35
36
WmB
AcC
AaB
StD
StB
VnD
Lu
Sm
CbE
Tc
Bt
VnD
AsB
TtD
TtB
Lw
BoD
TuB
AsC
AsD
int
Lv
TtB
At
AsC
WmB
AcC
ReD
36
40
287


1 2 320 000 FEET
R. 62 W.
165 000 FEET
T.3 S.
(Joins sheet 86)
19
20
21
30
29
31
32
33
TtD
AsB
AsC
AaB
AsD
AcC
NIB
Lu
WmB
SnB
AvC
int
Wolf
Creek
PlB
Sm
36
ARAPAHOE COUNTY

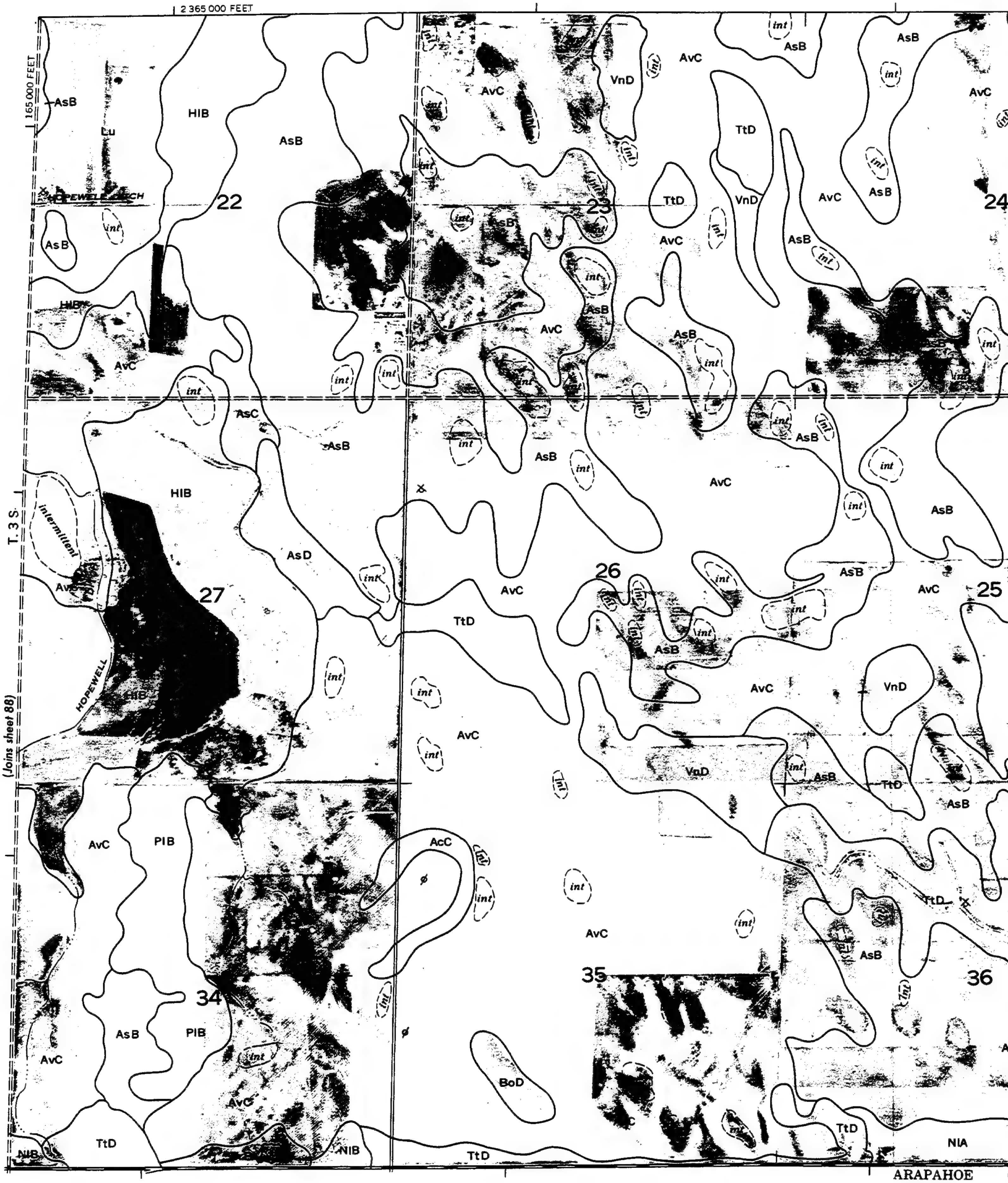


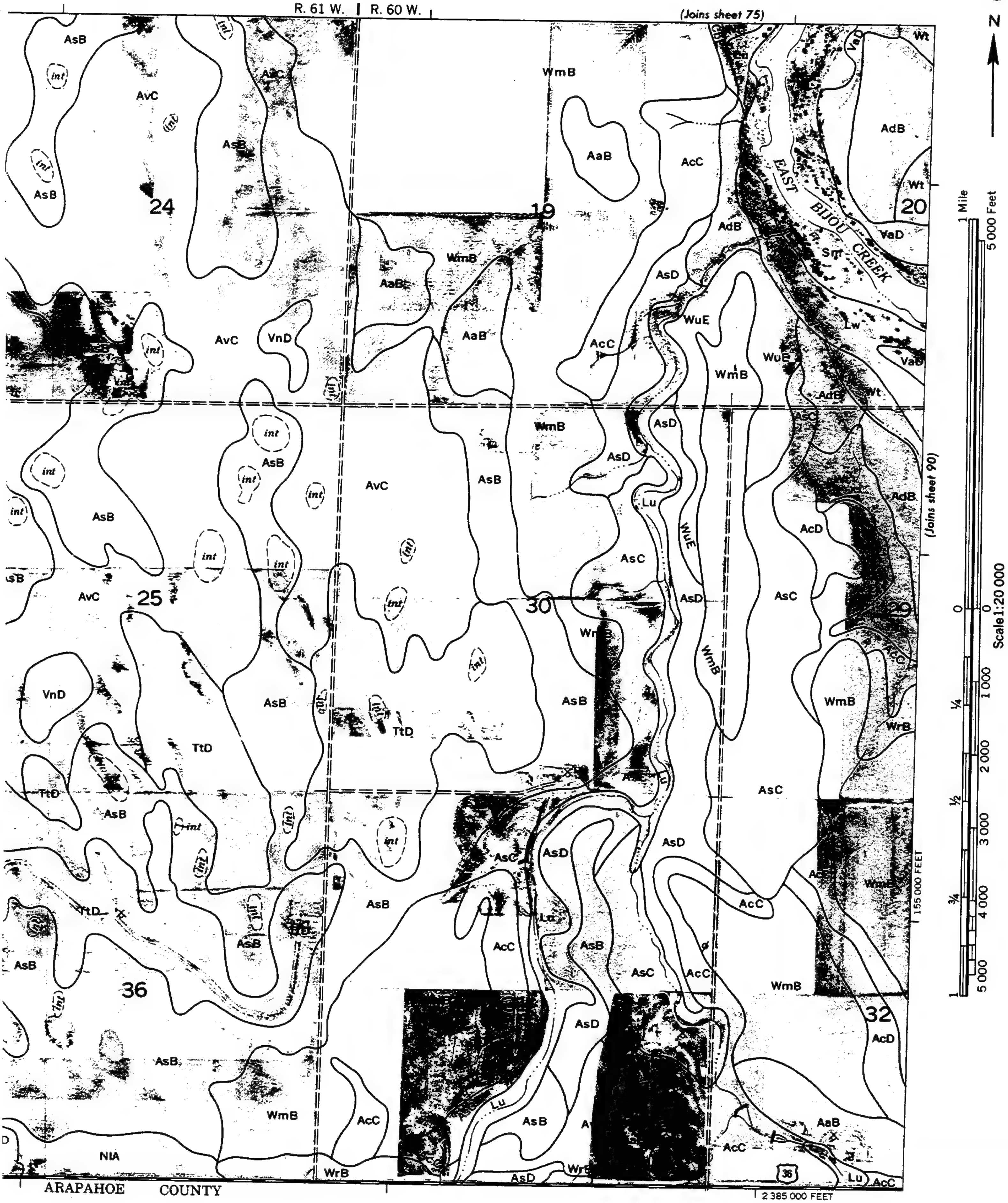
PAHOE COUNTY

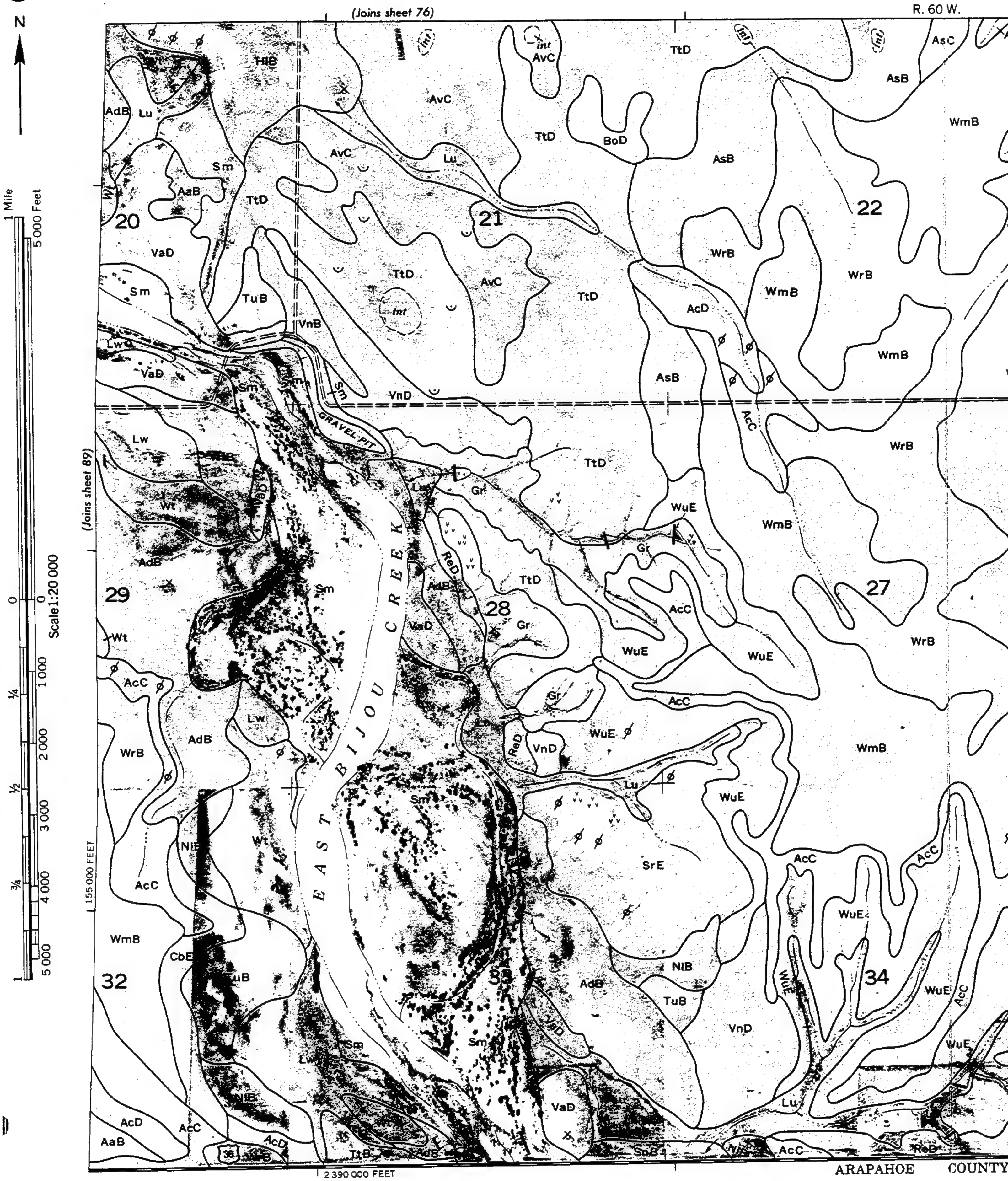

N
(Joins sheet 74)
R. 62 W. | R. 61 W.
(Joins sheet 87)
Scale 1:20 000
1 Mile
5 000 Feet
155 000 FEET
2 340 000 FEET
ARAPAHOE
23
24
19
26
30
35
36
31
Antelope
Creek
Spring
Gulch
AcC
AcD
WuE
AaB
VnD
Lu
AdB
TrE
WmB
WrB
TeD
ReD

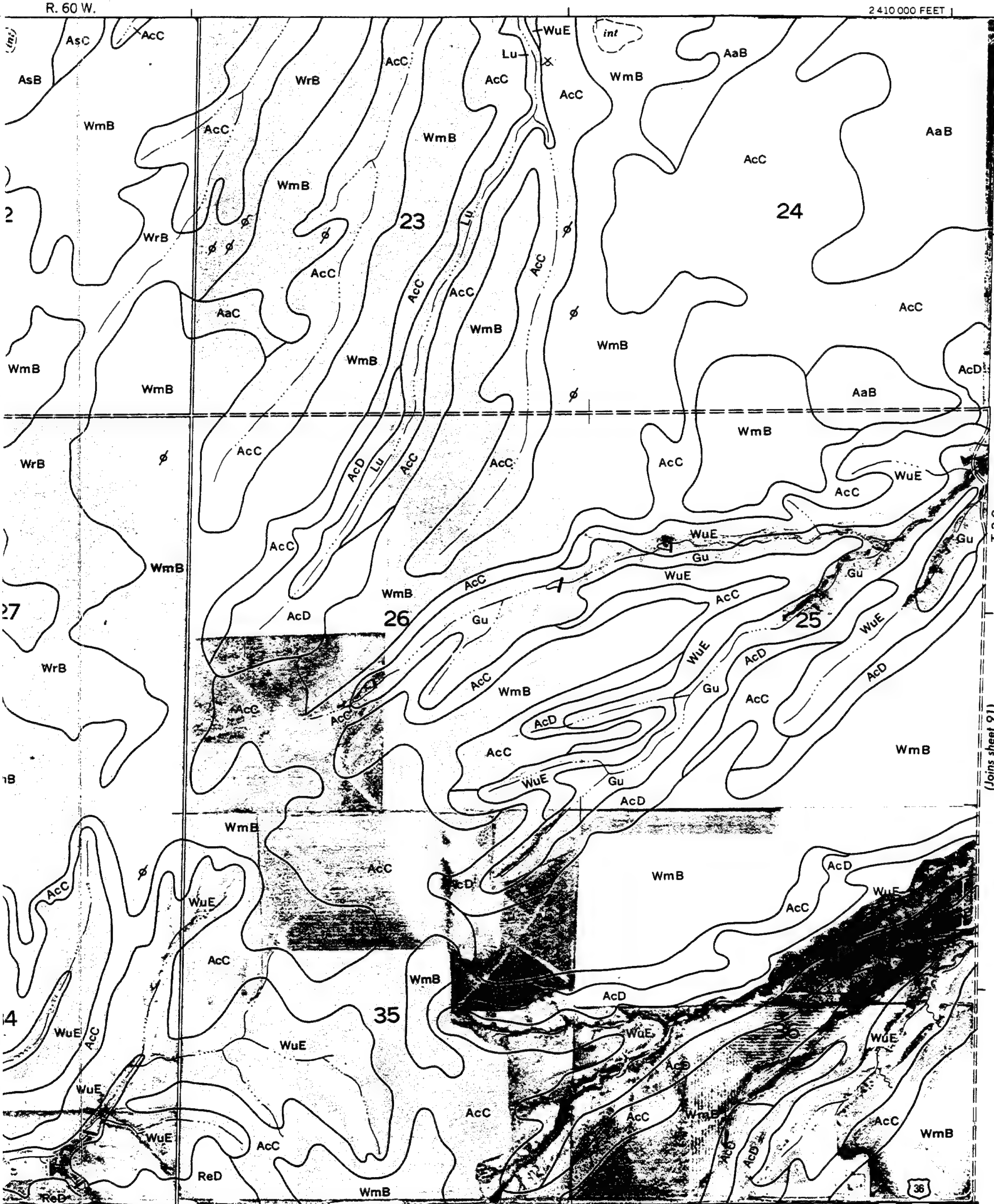


RAPAHOE COUNTY


2 365 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 88)
HOPEWELL DITCH
HOPEWELL
intermittent
22
23
24
26
27
25
34
35
36
AsB
HlB
Lu
AsC
AsD
AvC
VnD
TtD
PlB
AcC
BoD
NlB
NlA
int
ARAPAHOE

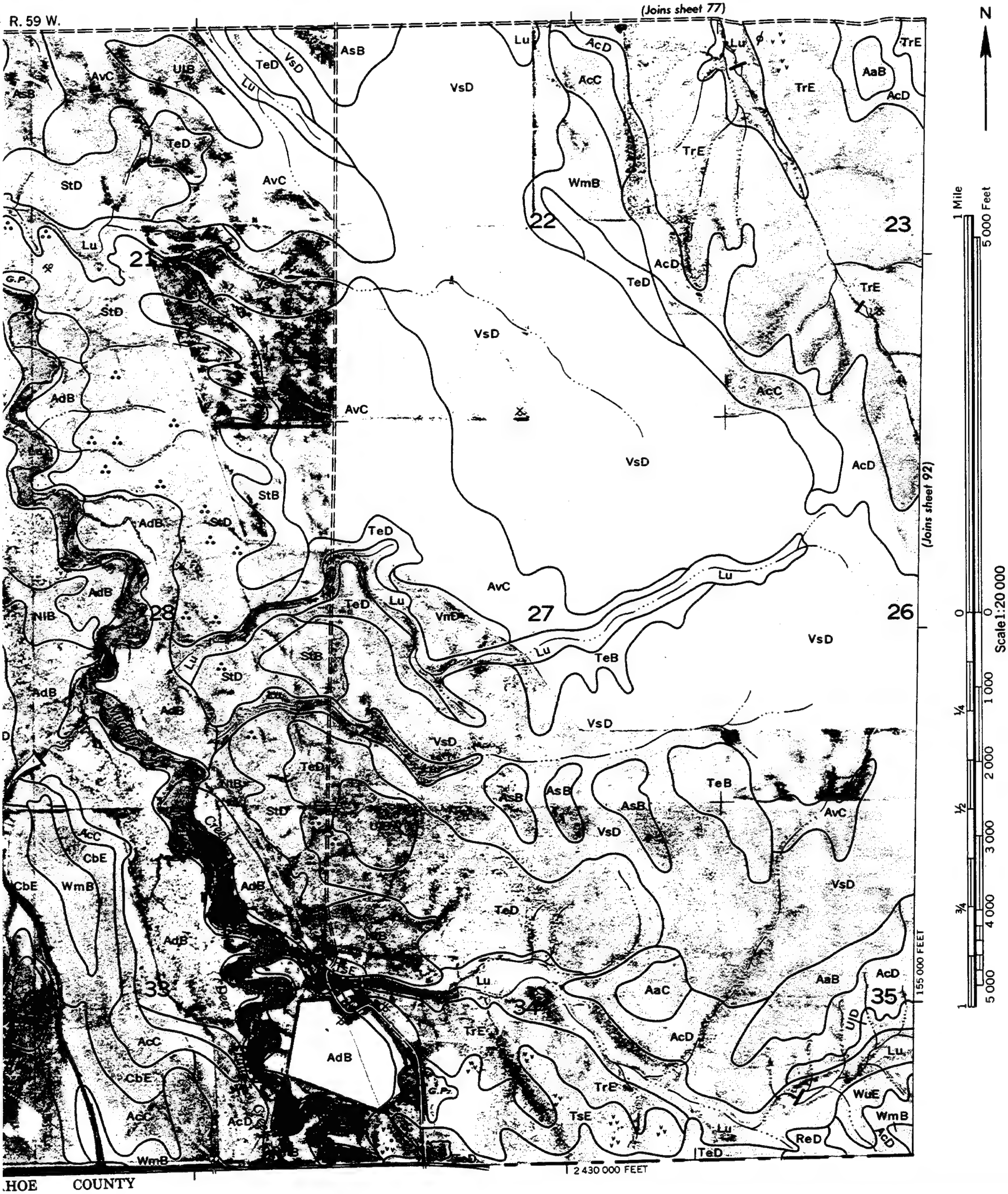

89
N
R. 61 W.
R. 60 W.
(Joins sheet 75)
(Joins sheet 90)
EAST BIJOU CREEK
24
19
20
25
30
29
36
32
AsB
AvC
AcC
WmB
AaB
AdB
AsD
WuE
VnD
TtD
AsC
AcD
WrB
Lu
NIA
Wt
VaD
Lw
AcC
AsB
36
Scale 1:20 000
1 Mile
5 000 Feet
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
155 000 FEET
2 385 000 FEET
ARAPAHOE COUNTY

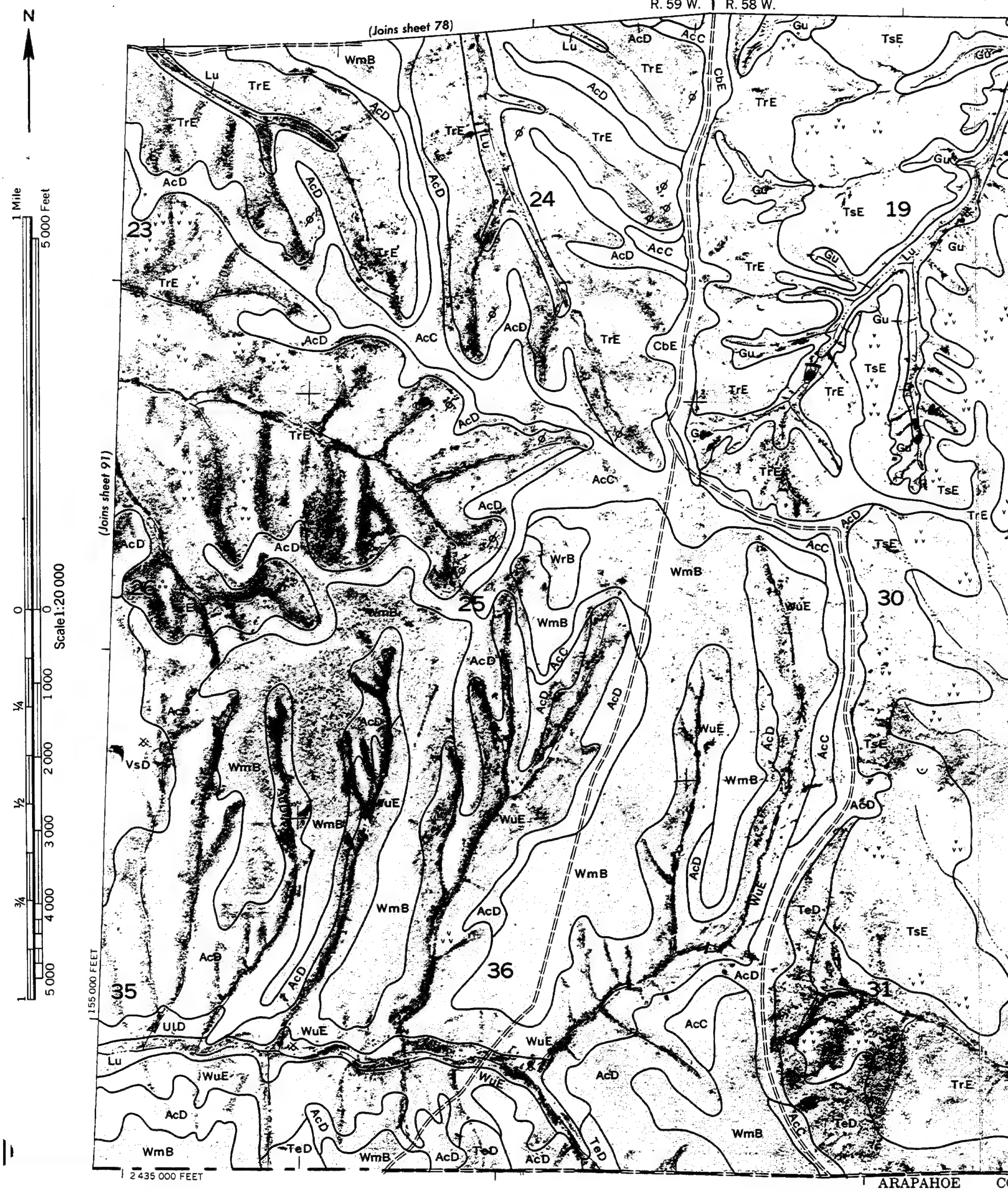

N
1 Mile
5 000 Feet
0
0
¼
1 000
2 000
½
3 000
¾
4 000
5 000
1
Scale 1:20 000
(Joins sheet 76)
R. 60 W.
(Joins sheet 89)
155 000 FEET
2 390 000 FEET
ARAPAHOE COUNTY
EAST BIJOU CREEK
GRAVEL PIT
20
21
22
27
28
29
32
33
34
HlB
AdB
Lu
Sm
AaB
TtD
VaD
TuB
VnB
Lw
Wt
AvC
BoD
AsB
AsC
WmB
WrB
AcD
AcC
VnD
Gr
ReD
WuE
SrE
NlB
CbE
SpB
TtB
int

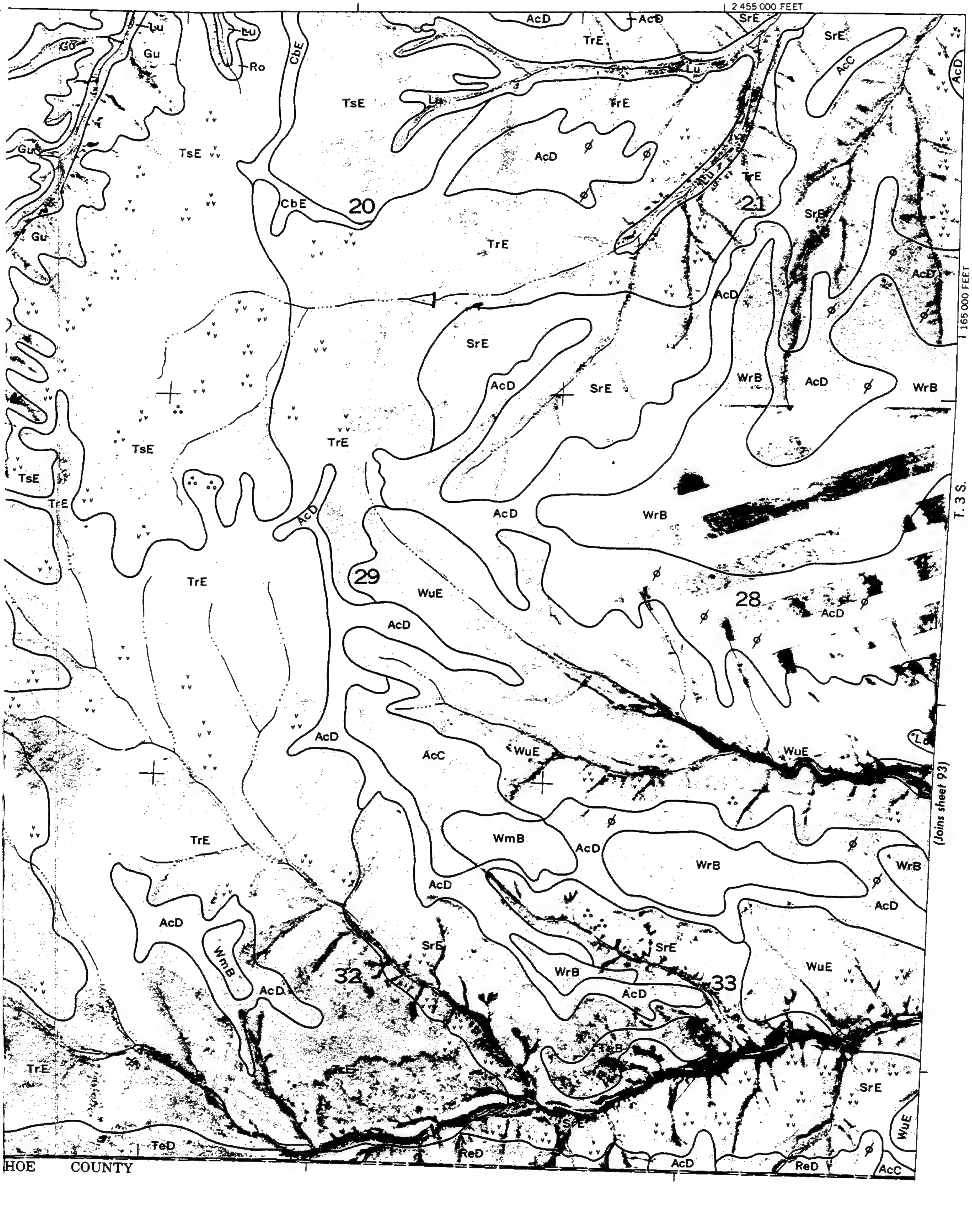

R. 60 W.
2 410 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 91)
23
24
25
26
27
35
AsC
AsB
AcC
AcD
AaB
AaC
WmB
WrB
WuE
Lu
Gu
ReD
int
36

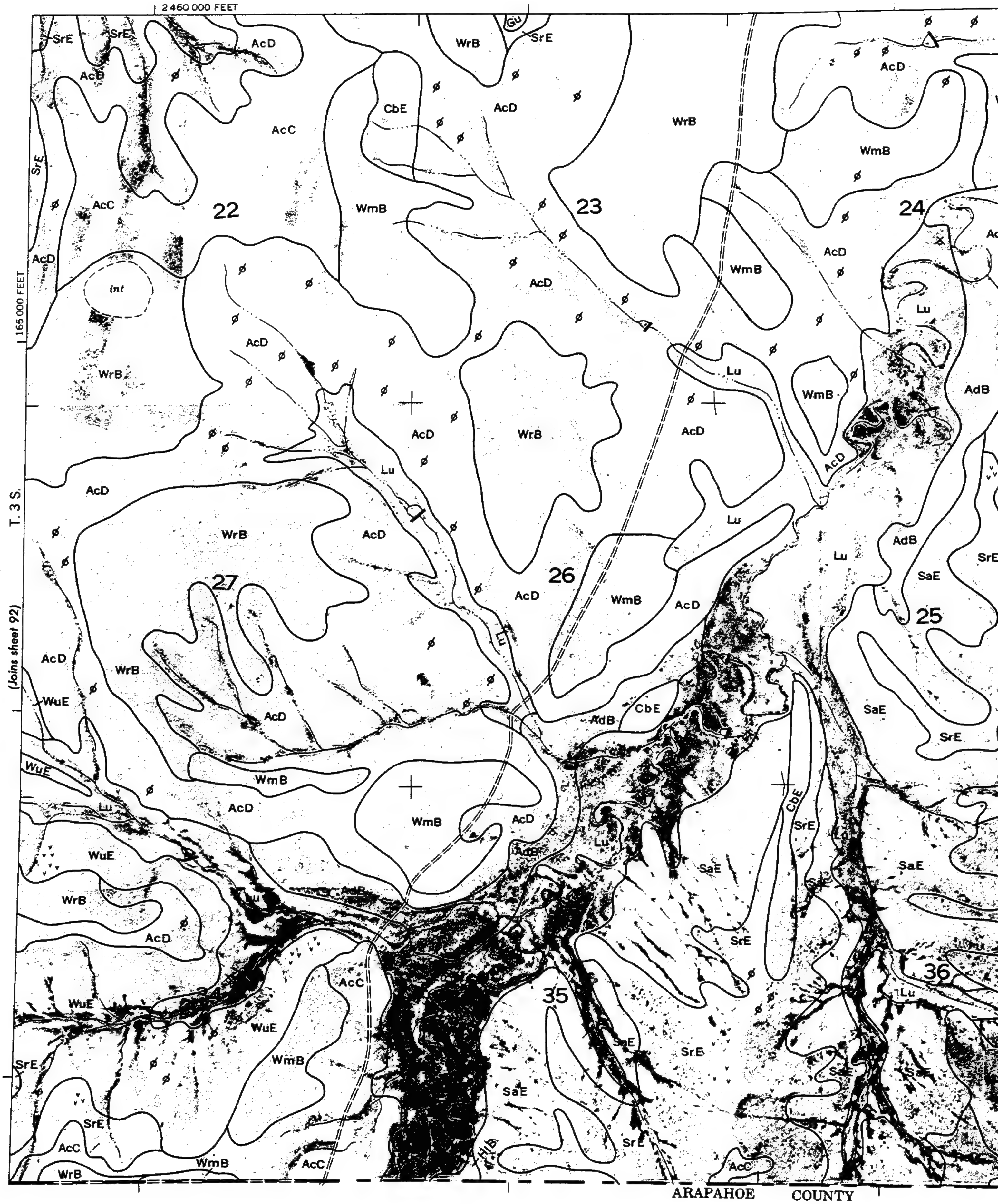
AHOE COUNTY

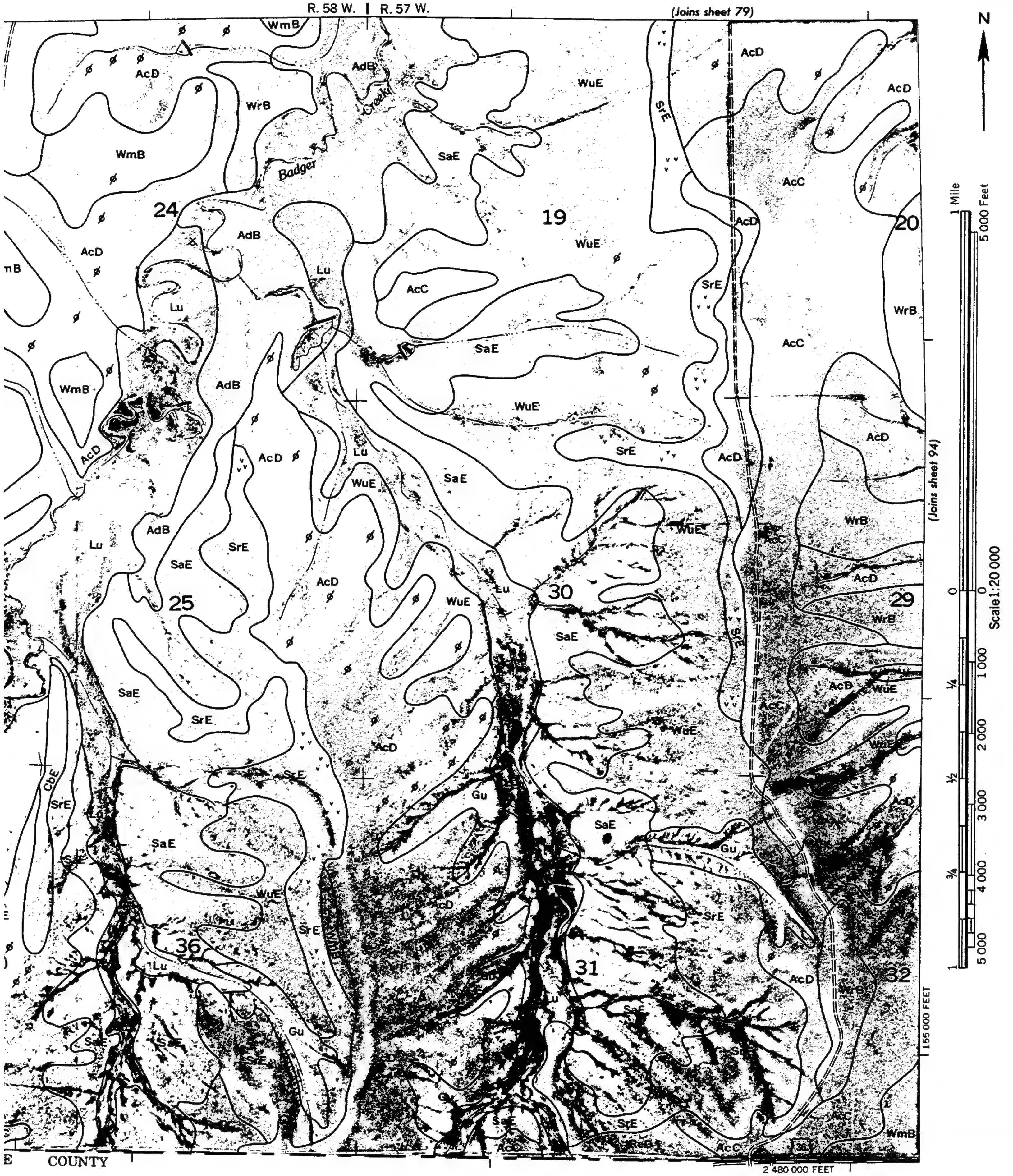

2 415 000 FEET
R. 59 W.
165 000 FEET
T. 3 S.
(Joins sheet 90)
19
20
30
31
32
AcD
AcC
AaB
AdB
TeD
WuE
WmB
WrB
Lu
Gu
StD
PlB
AsB
VnD
Muddy
Creek
G.P.
Lone Tree Gulch
Gulch
AsC
CbE
SrE
SaE
NlB
CbE
Int
ARAPAHOE


(Joins sheet 77)
(Joins sheet 92)
R. 59 W.
N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
155 000 FEET
2 430 000 FEET
21
22
23
26
27
28
33
34
35
AsB
AvC
UlB
TeD
VsD
Lu
AcD
AcC
TrE
AaB
StD
AvC
WmB
G.P.
AdB
StB
NlB
VnD
TeB
CbE
AcC
WmB
AaC
TsE
ReD
WuE
UlD
Creek
Deer

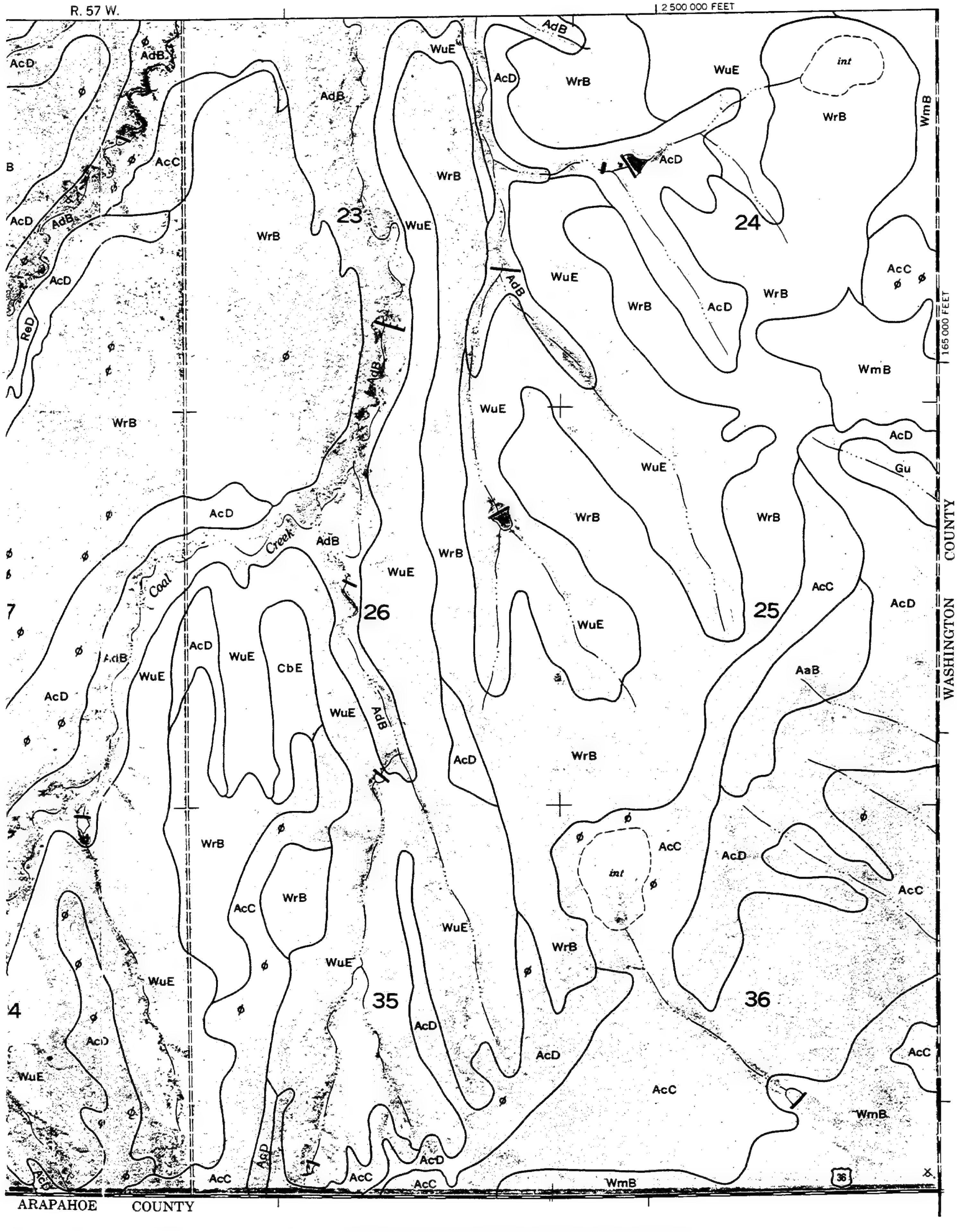

N
1 Mile
5 000 Feet
Scale 1:20 000
0
1/4
1/2
3/4
1
1 000
2 000
3 000
4 000
5 000
R. 59 W.
R. 58 W.
(Joins sheet 78)
(Joins sheet 91)
155 000 FEET
2 435 000 FEET
ARAPAHOE CO
23
24
19
25
26
30
35
36
31
WmB
TrE
Lu
AcD
AcC
CbE
Gu
TsE
WrB
WuE
VsD
TeD
ULD

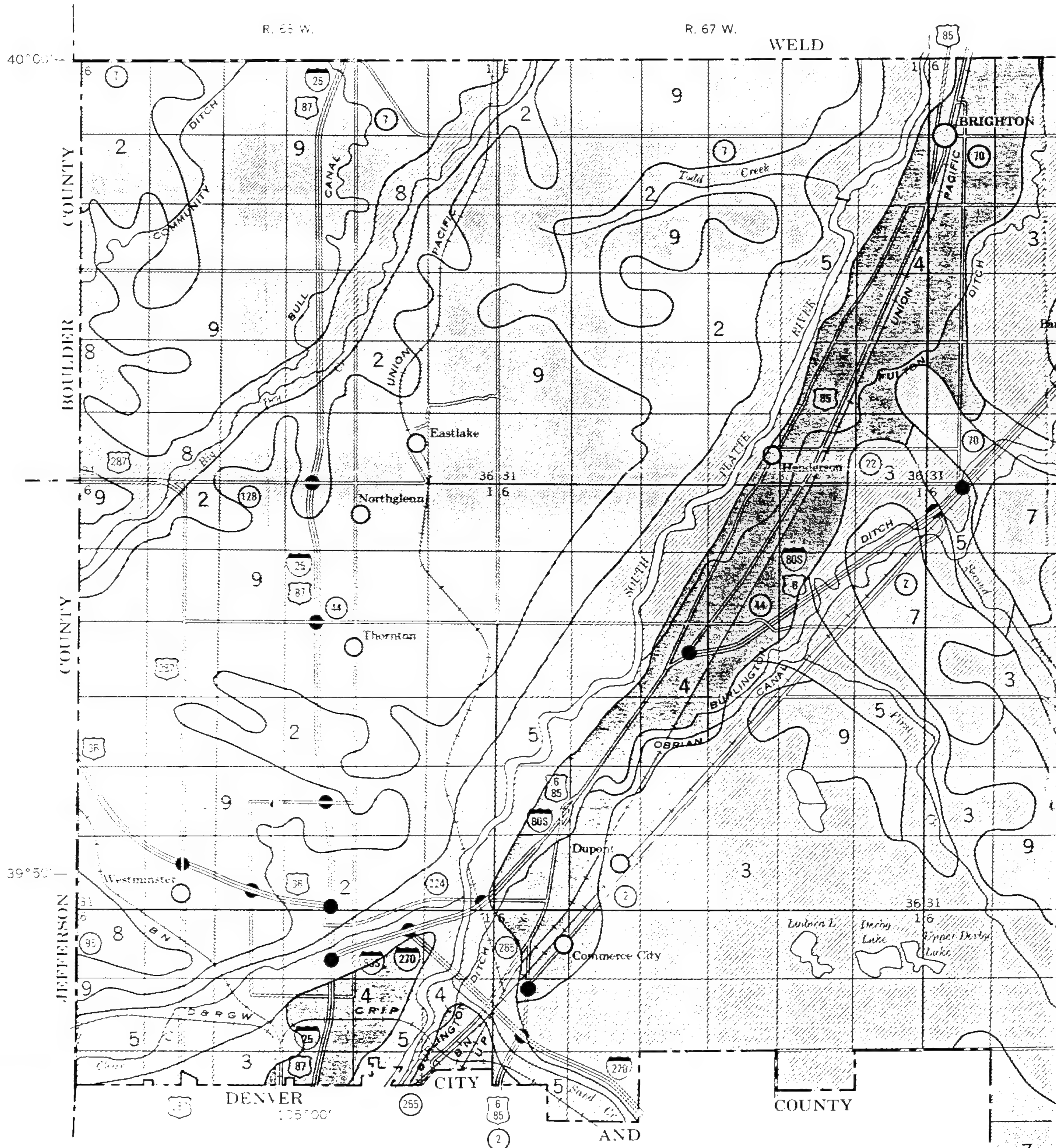

2 455 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 93)
20
21
29
28
32
33
AcD
AcC
SrE
TrE
TsE
CbE
Gu
Lu
Ro
WrB
WuE
WmB
TeB
TeD
ReD


2 460 000 FEET
165 000 FEET
T. 3 S.
(Joins sheet 92)
22
23
24
25
26
27
35
36
SrE
AcD
AcC
WrB
CbE
WmB
Lu
AdB
SaE
WuE
int
Gu
HlB
ARAPAHOE
COUNTY

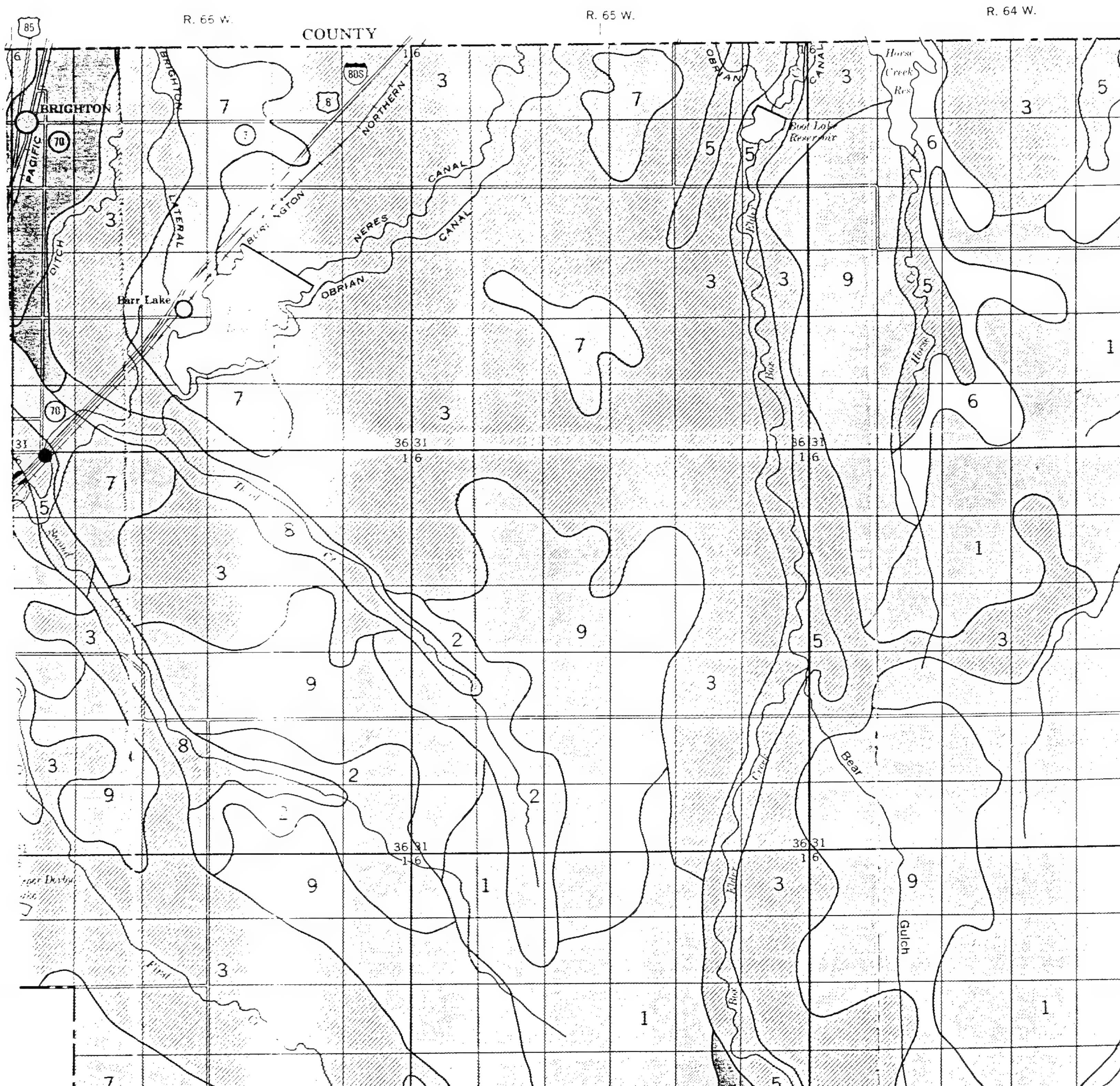

R. 58 W.
R. 57 W.
(Joins sheet 79)
(Joins sheet 94)
N
1 Mile
5 000 Feet
Scale 1:20 000
0
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
155 000 FEET
2 480 000 FEET
COUNTY
Badger Creek
19
20
24
25
29
30
31
32
36
AcC
AcD
AdB
CbE
Gu
Lu
SaE
SrE
WmB
WrB
WuE

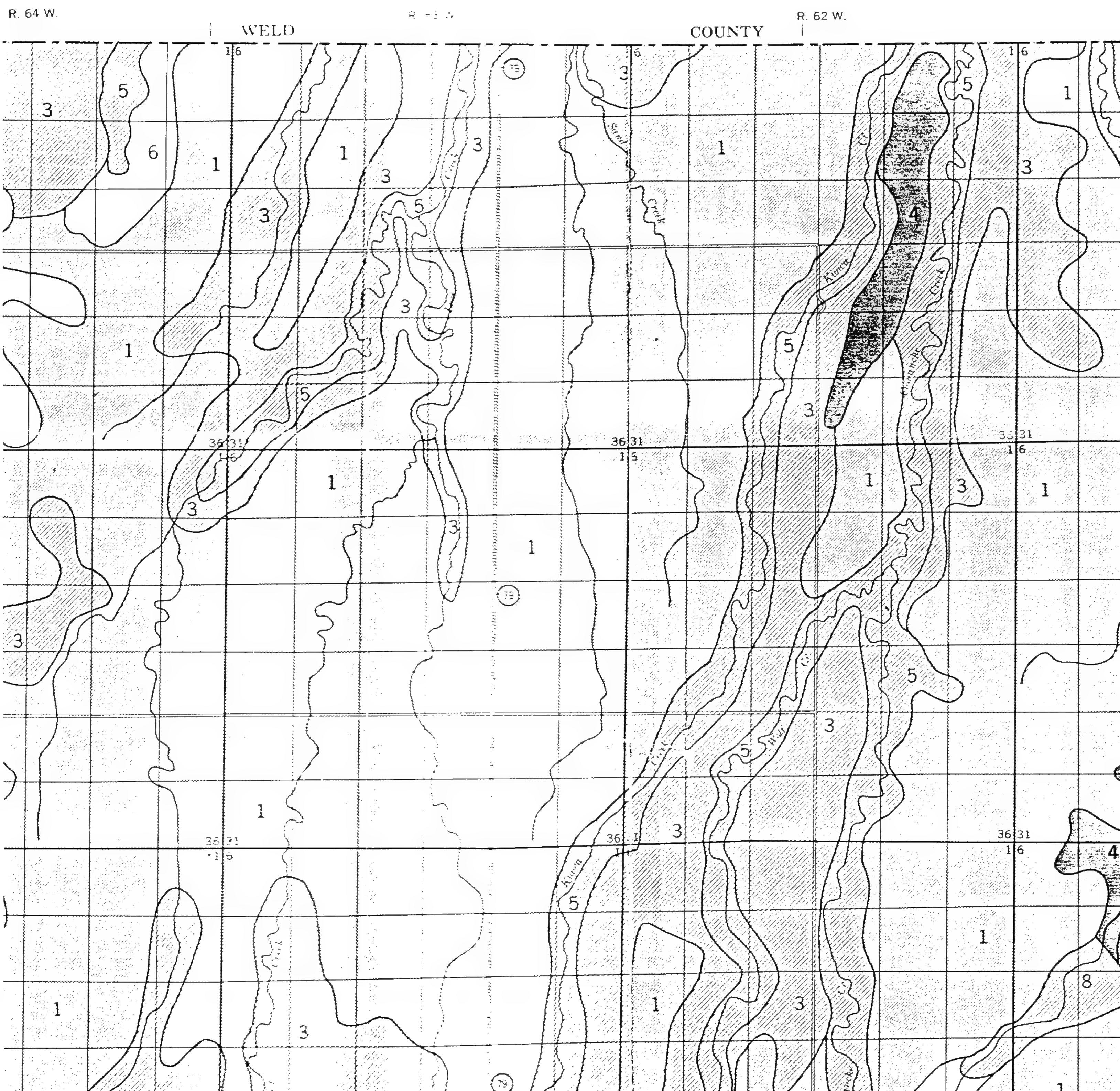

N
1 Mile
5 000 Feet
0
Scale 1:20 000
¼
½
¾
1
1 000
2 000
3 000
4 000
5 000
(Joins sheet 80)
R. 57 W.
(Joins sheet 93)
T. 3 S.
155 000 FEET
2 485 000 FEET
ARAPAHOE
20
21
22
27
28
29
32
33
34
AcD
WrB
WmB
WuE
Gu
AdB
ReD
Lu
AcC
AaB
SaE
36


R. 57 W.
2 500 000 FEET
165 000 FEET
23
24
25
26
35
36
Coal Creek
WASHINGTON COUNTY
ARAPAHOE COUNTY
AcD
AdB
AcC
WrB
WuE
WmB
CbE
AaB
ReD
Gu
int
36

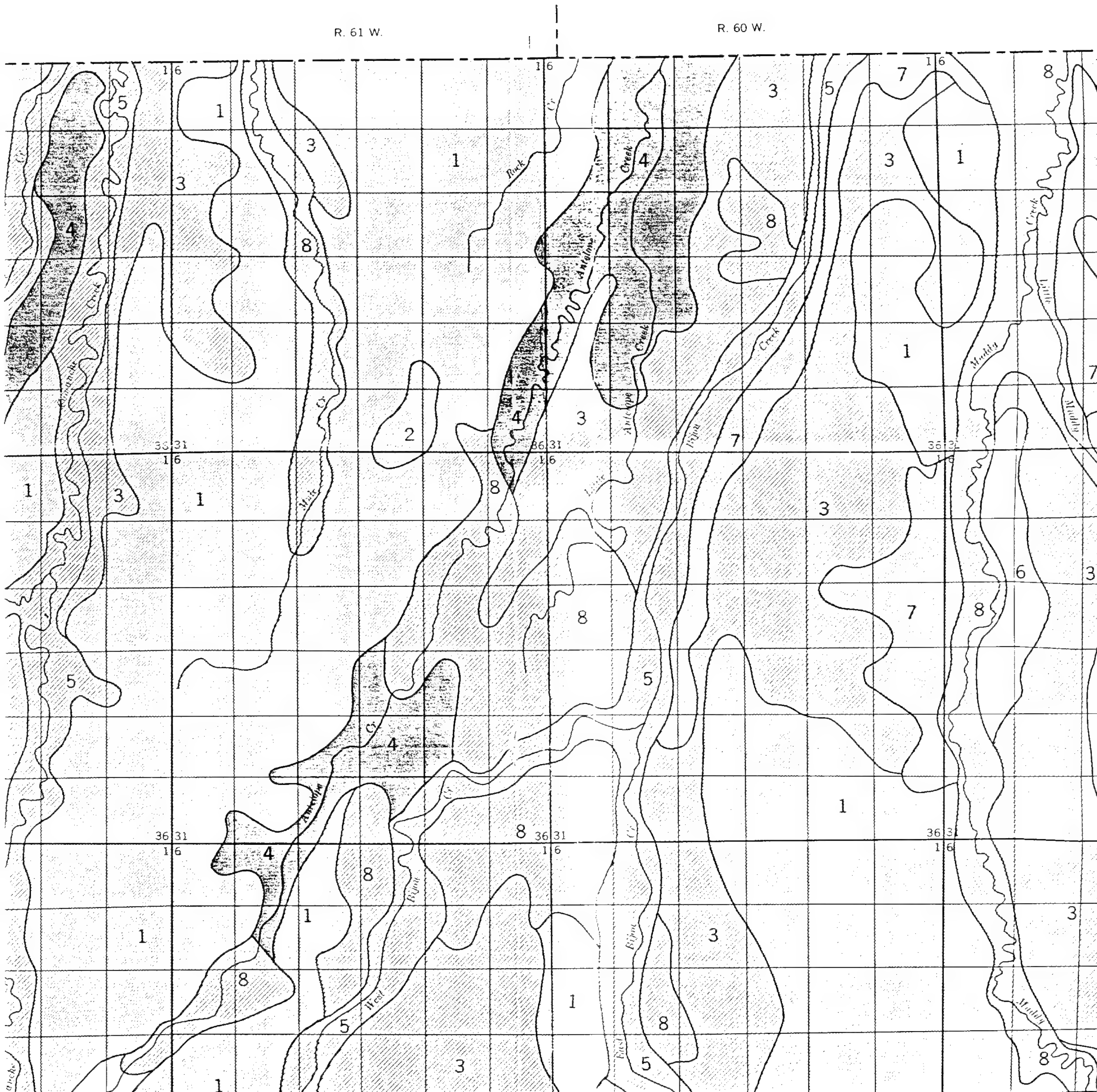


R. 67 W.
WELD
BOULDER
COUNTY
JEFFERSON
COUNTY
BRIGHTON
Eastlake
Northglenn
Thornton
Henderson
Westminster
Dupont
Commerce City
DENVER
CITY
AND
COUNTY
Todd Creek
SOUTH PLATTE RIVER
BULL CANAL
COMMUNITY DITCH
UNION PACIFIC
BURLINGTON CANAL
FULTON DITCH
OBRIAN
40°00'
39°50'

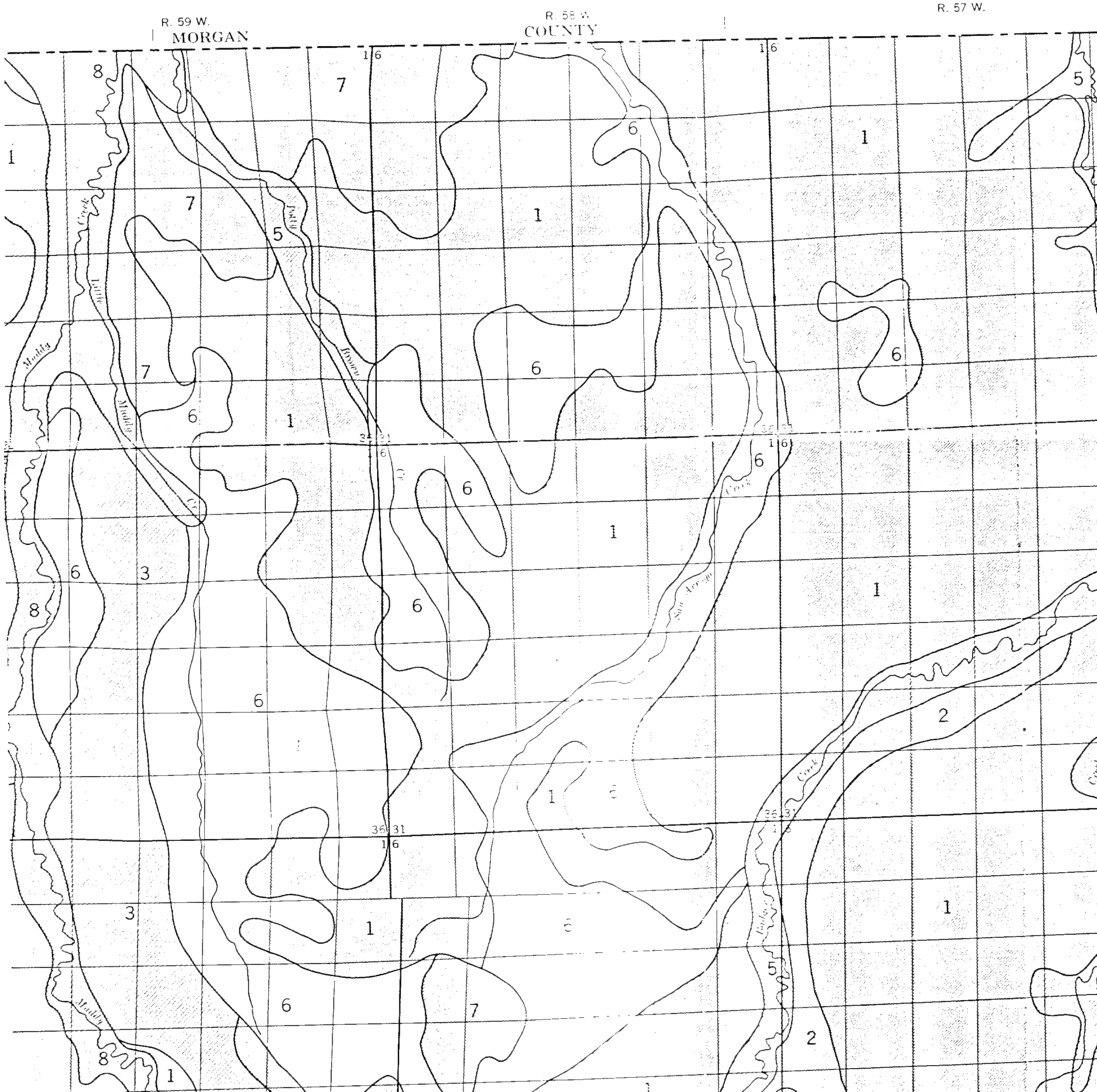

R. 65 W.
R. 65 W.
R. 64 W.
COUNTY
BRIGHTON
PACIFIC
DITCH
BRIGHTON
LATERAL
NORTHERN
CANAL
NERES
CANAL
OBRIAN
Barr Lake
OBRIAN
CANAL
Horse
Creek
Res
Boot Lake
Reservoir
Box
Elder
Horse
Bear
Gulch
Creek
Elder
Box
First

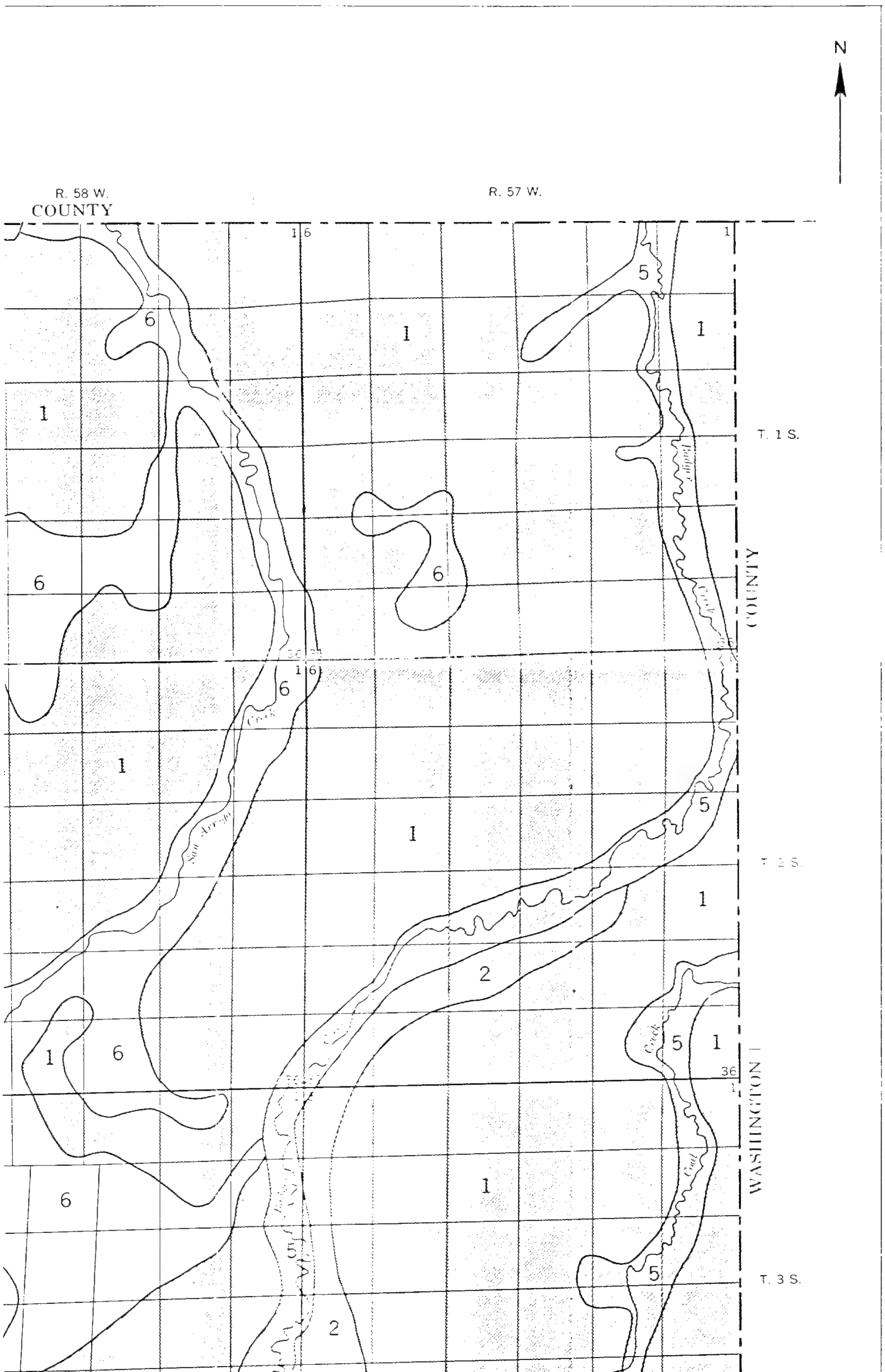


R. 64 W.
R. 62 W.
WELD
COUNTY
Kiowa Cr.
Comanche Creek
Wolf Cr.
Sand Creek

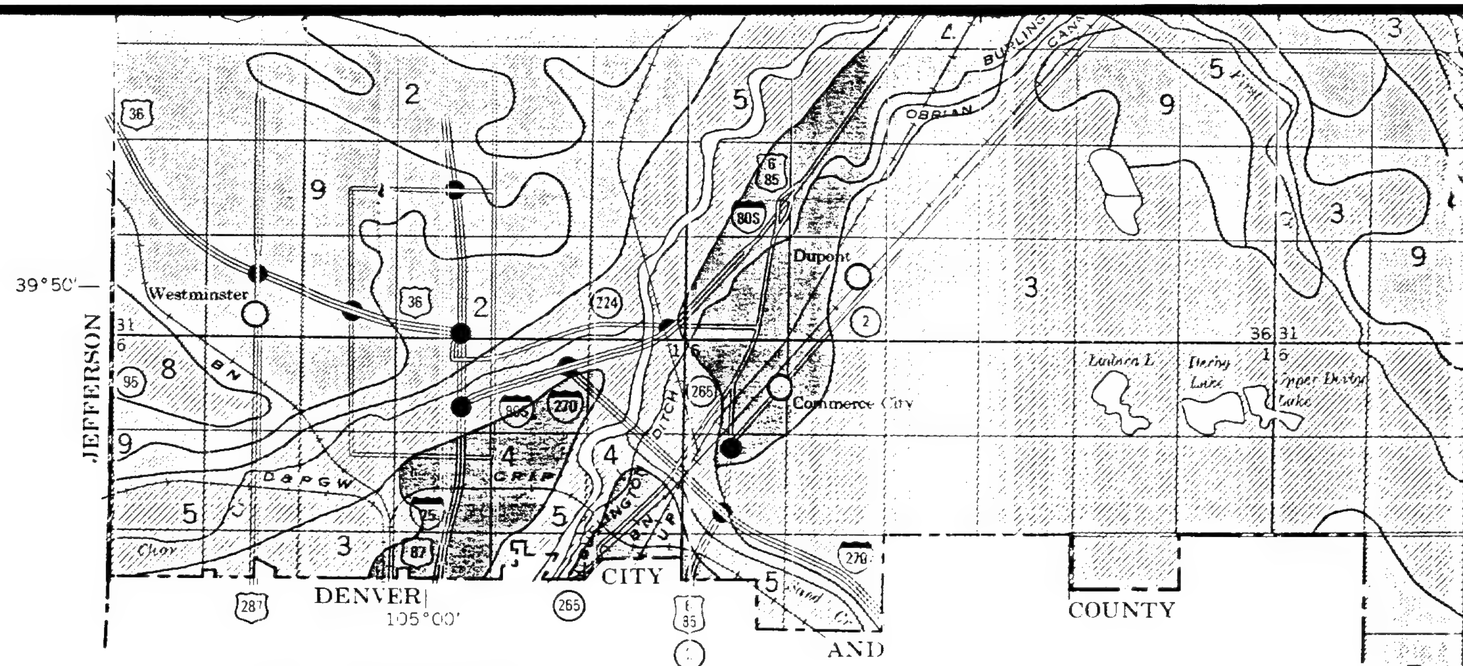


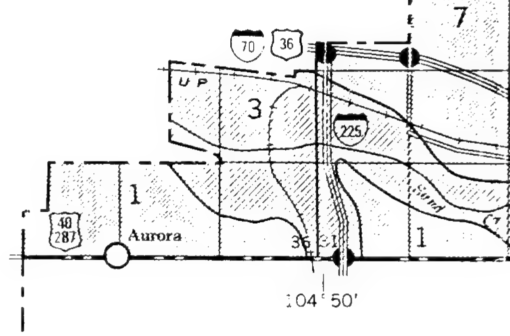
R. 61 W.
R. 60 W.
Rock Cr.
Antelope Creek
Little Antelope Creek
Bijou Creek
Muddy Creek
Little Muddy
West Bijou Cr.
East Bijou


R. 59 W.
MORGAN
R. 58 W.
COUNTY
R. 57 W.
Little Muddy Creek
Muddy
Bijou Creek
San Arroyo Creek
Badger Creek



N
R. 58 W.
R. 57 W.
COUNTY
T. 1 S.
COUNTY
T. 2 S.
WASHINGTON
T. 3 S.
San Arroyo Creek
Badger Creek
Coal Creek



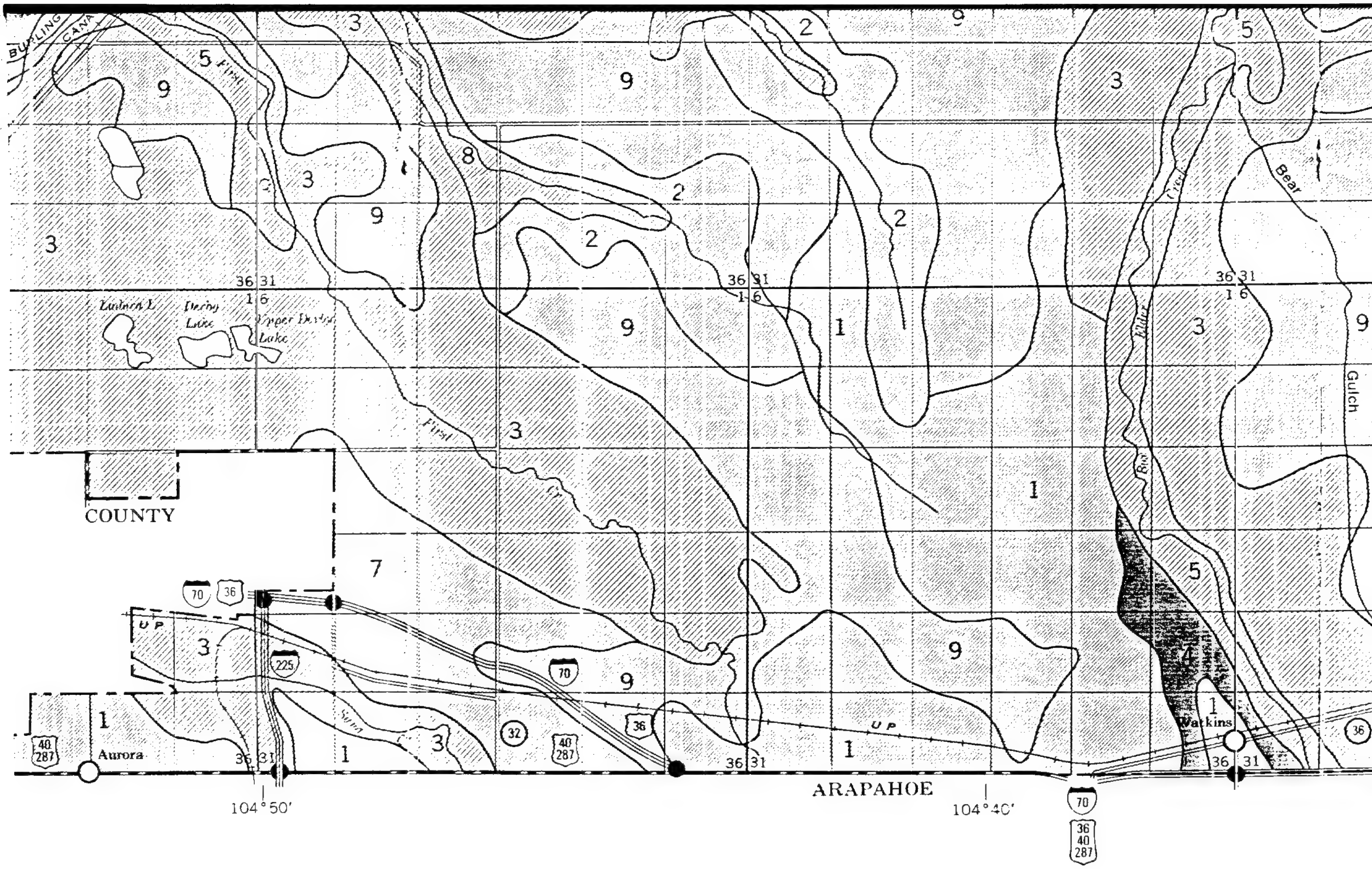


SOIL ASSOCIATIONS*

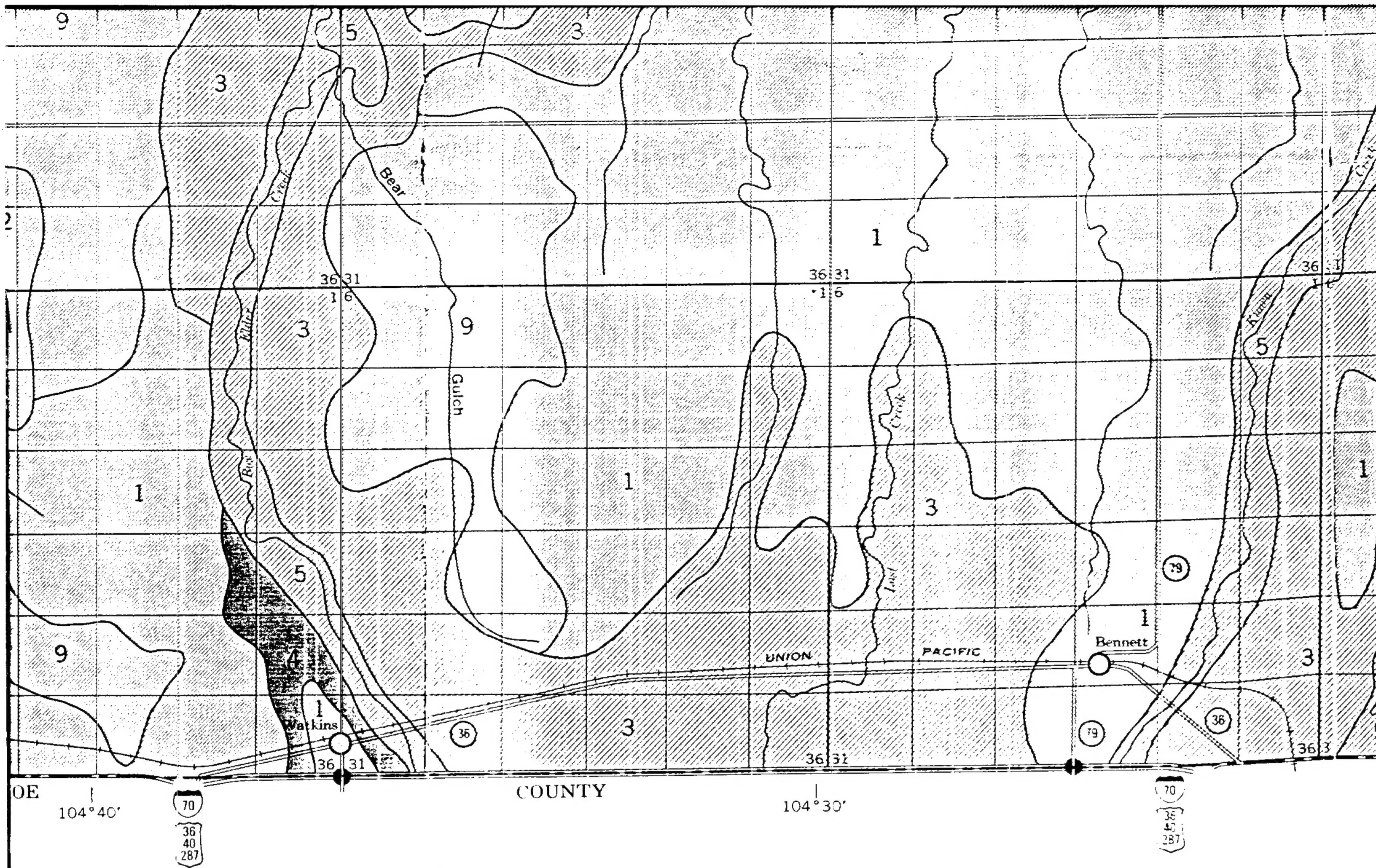
1	Weld-Adena-Colby association: Nearly level to steep, well-drained, loamy soils formed in wind-laid deposits; on uplands
2	Samsil-Shingle association: Sloping to steep, excessively drained, clayey and loamy soils formed in materials from soft shale and sandstone; on uplands
3	Ascalon-Vona-Truckton association: Nearly level to strongly sloping, well-drained and somewhat excessively drained, loamy and sandy soils formed in wind-laid deposits; on uplands
4	Nunn-Satanta association: Nearly level, well-drained, loamy soils formed in alluvial materials that are underlain by gravel in some places; on terraces and fans
5	Alluvial land association: Nearly level, poorly drained to well-drained, loamy and sandy soils formed in stream and river deposits; on flood plains
6	Terry-Renohill-Tassel association: Gently sloping to steep, well-drained and somewhat excessively drained, loamy soils formed in materials from soft sandstone and shale; on uplands
7	Blakeland-Valent-Terry association: Undulating to hilly, somewhat excessively drained, dominantly sandy soils; on uplands
8	Arvada-Heldt-Nunn association: Nearly level, well drained, loamy and clayey soils formed in alluvium; on terraces and fans
9	Platner-Ulm-Renohill association: Nearly level to strongly sloping, well-drained, loamy soils formed in old alluvium on interbedded shale and sandstone; on uplands

*Texture refers to the surface layer of the major soils unless otherwise stated.

Compiled 1972



COUNTY
ARAPAHOE
Aurora
Watkins
Ladora L.
Derby Lake
Upper Derby Lake
First
Sand
Box Elder Creek
Bear
Gulch
104°50′
104°40′



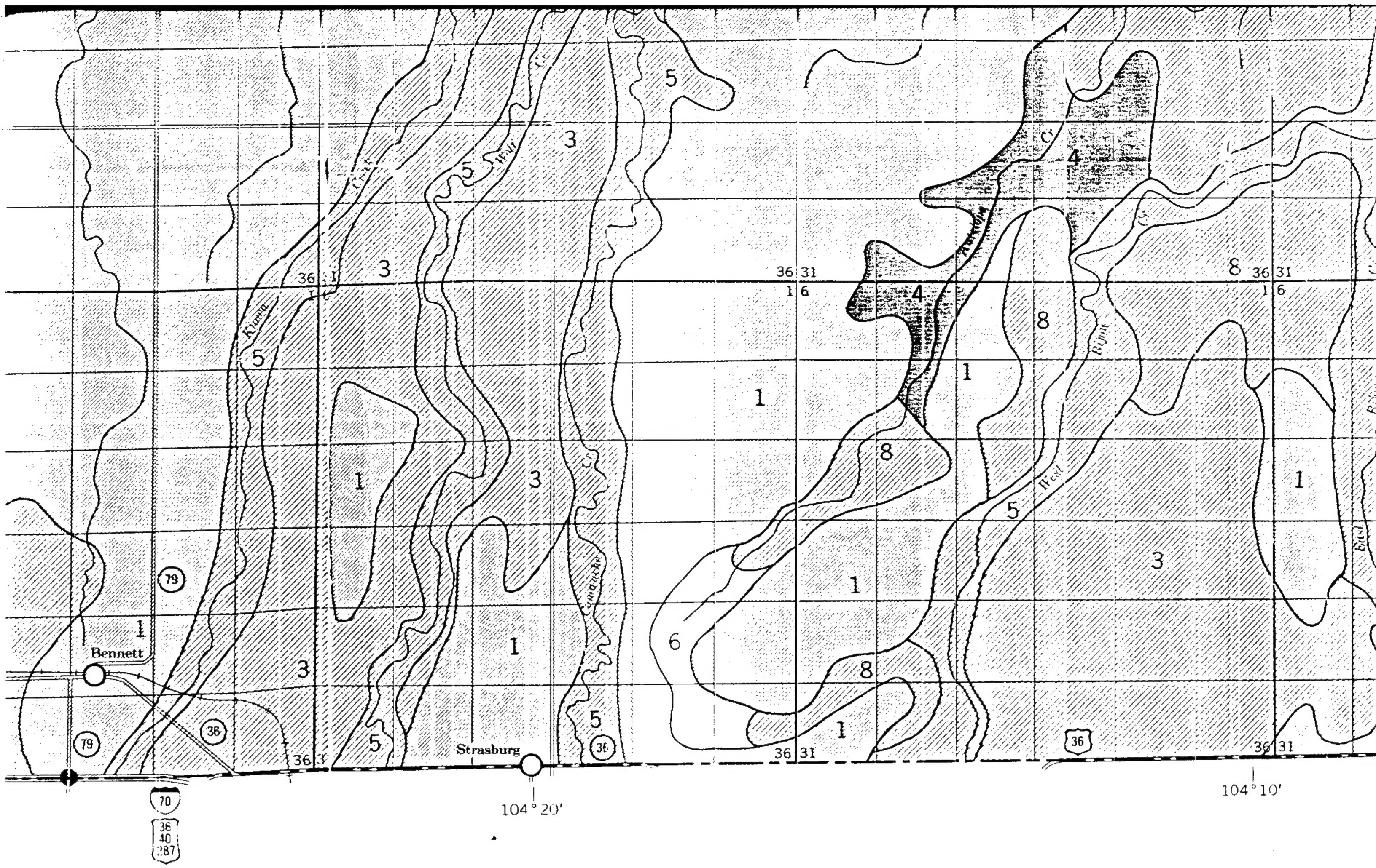
U. S. DEPARTMENT OF A
SOIL CONSERVATION
COLORADO AGRICULTURAL EXP

GENERAL SO

ADAMS COUNTY, C

Scale 1:1 6,720

81266R54
Original



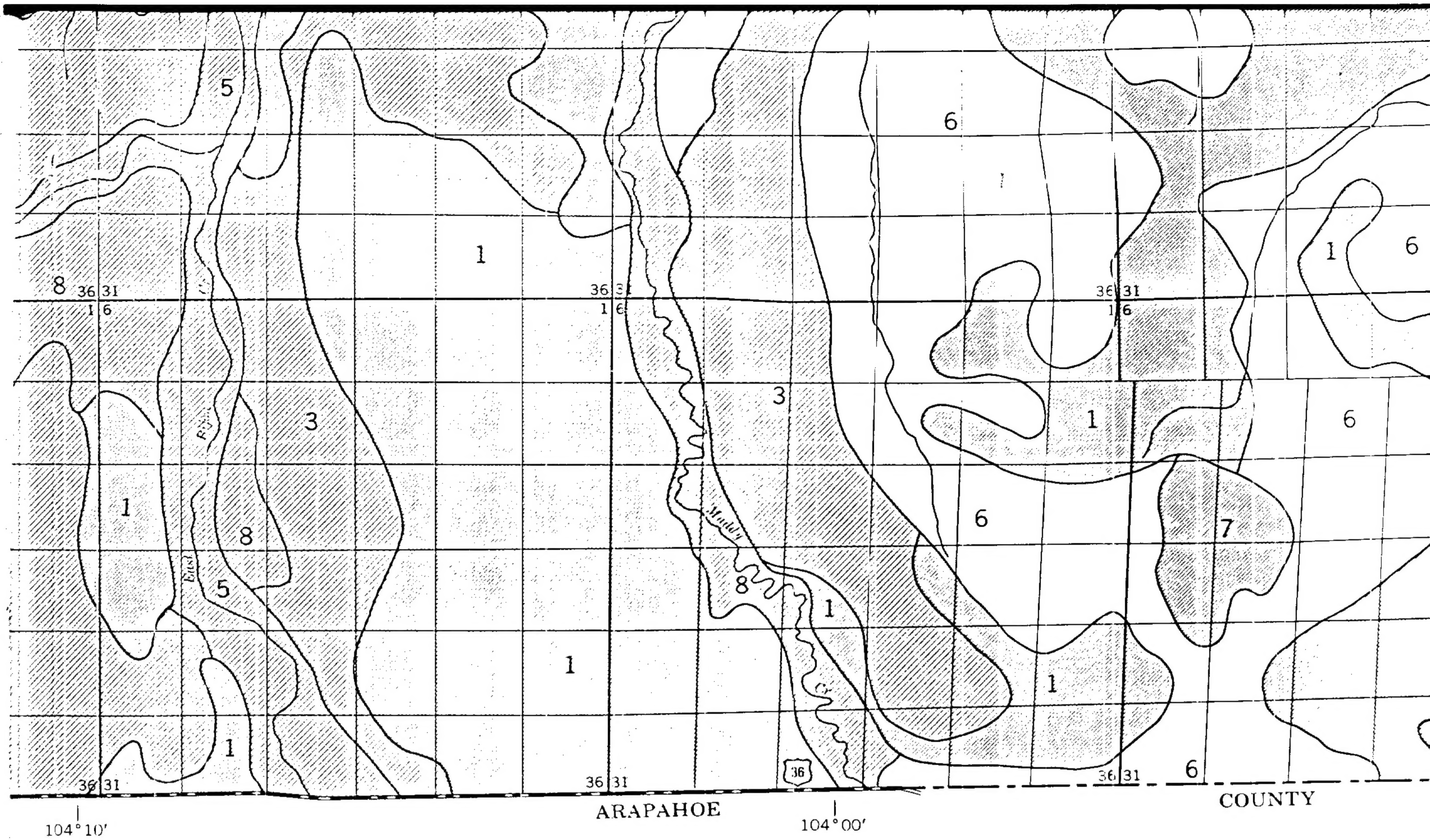
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
COLORADO AGRICULTURAL EXPERIMENT STATION

GENERAL SOIL MAP

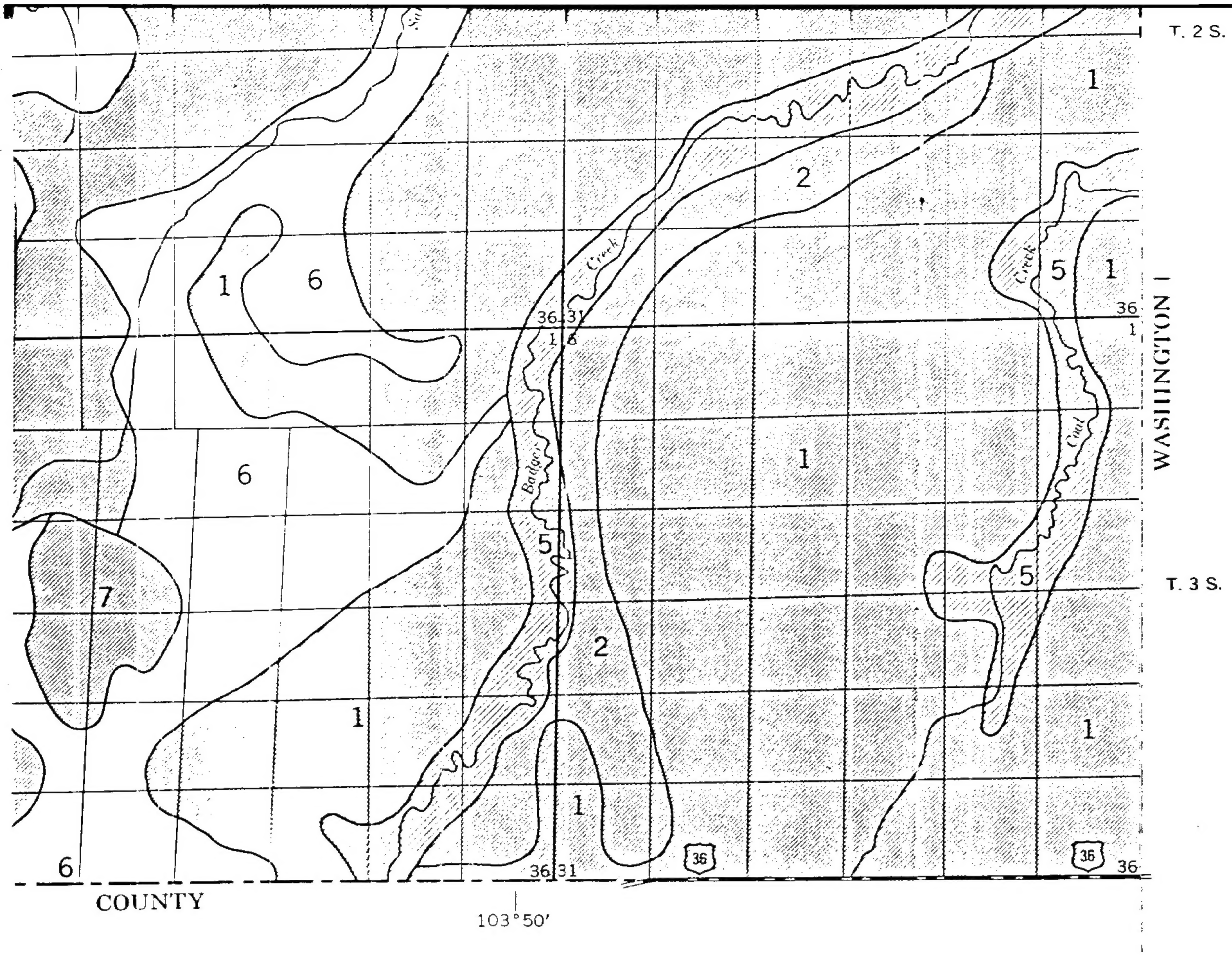
ADAMS COUNTY, COLORADO

Scale 1:126,720

1 0 1 2 3 4 Miles



5
6
1
1
6
8
36 31
1 6
36 31
1 6
36 31
1 6
3
3
1
6
1
8
East
Muddy
6
7
5
8
1
1
1
1
36 31
36 31
36 31
6
36
ARAPAHOE
COUNTY
104° 10′
104° 00′



SECTIONALIZED TOWNSHIP

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

Each area outlined on this map consists of more than one kind of soil. The map is thus meant for general planning rather than a basis for decisions on the use of specific tracts.